

SPECIFICATIONS MANUAL

DIVISIONS 00-33

CLACKAMAS FIRE TRAINING WAREHOUSE

Clackamas, OR

12-20-24



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**SECTION 00 11 13
INVITATION TO BID**

SECTION 00 11 13 – INVITATION TO BID

1.1 PROJECT INFORMATION

- A. Notice to Bidders: Qualified bidders may submit bids for project as described in this Document. Submit bids according to the Instructions to Bidders.
 - 1. Regulatory Requirements: Oregon Revised Statutes Chapter 279C shall govern submittal, opening, and award of bids.
- B. Project Identification: Clackamas Fire District Training Warehouse.
 - 1. Project Location: 16170 SE 130th Ave, Clackamas, OR 97015.
- C. Owner: Clackamas Fire District
11300 SE Fuller Rd, Milwaukie, OR 97222.
- D. Architect: Scott Edwards Architecture, LLP
2525 E. Burnside St
Portland, OR 97214
- E. Project Description: Project is a tenant improvement and consists of the construction of new non-structural walls and finishes.
 - 1. Project cost range is anticipated to be under **\$450,000**.
- F. Construction Contract: Bids will be received for the following Work:
 - 1. General Contract (all trades).

1.2 BID SUBMITTAL AND OPENING

- A. Owner will receive sealed lump sum bids until the bid time and date at the location given below. Owner will consider bids prepared in compliance with the Instructions to Bidders issued by Owner, and delivered as follows:
 - 1. Bid Date: January 30, 2025.
 - 2. Bid Time: **2:00 p.m.**, local time.
 - 3. Location: Clackamas Fire District, Station #1
11300 SE Fuller Rd.
Milwaukie, OR 97222
- B. Bids will be thereafter publicly opened and read aloud.

1.3 BIDDING DOCUMENTS

- A. Online Procurement and Contracting Documents: All bidding documents can be found on the district website.
- B. Questions or requests for clarification shall be directed in writing to the Architect, via email at bdole@seallp.com. All written questions must be received by 2:00pm, prevailing local time, **Thursday January 23, 2025**. The Architect will determine appropriate responses, if any, and if necessary, an Addendum will be issued to all plan holders of record by January 27, 2025. Any verbal response(s) obtained from any source by bidders will be considered information and shall not be relied upon by bidders.

1.4 PREBID MEETING

- A. Prebid Meeting: A Mandatory Prebid meeting for all bidders will be held in person on **Tuesday January 14, 2025, at 10:00 a.m.**, prevailing local time. Prospective prime bidders are **required** to attend.
 - 1. Bidders' Questions: Architect will provide responses at Prebid conference to bidders' questions received up to two (2) business days prior to conference.

1.5 BID SECURITY

- A. Bid security in the form of a cashier's check or Bid Bond per Section 00 43 13 of the Project Manual shall be submitted with each bid in the amount of five (5%) percent of the bid amount. No bids may be withdrawn for a period of sixty (60) days after opening of bids.

**SECTION 00 11 13
INVITATION TO BID**

Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.6 FIRST TIER SUBCONTRACTOR DISCLOSURE

- A. All bidders must complete and submit the First Tier Subcontractor Disclosure Form per State of Oregon Revised Statutes (ORS) ORS 279C.370 as required by Section 00 45 21 of the Project Manual by **3:00pm on the day set for opening of bids**. The first tier Subcontractor Disclosure Form, if submitted separately, shall be submitted in a sealed envelope plainly marked on the outside with project name, bid date and time, "First Tier Subcontractor Disclosure Form", bidder's name and contractor's Oregon stat CCB license number. The Owner must reject a bid as non-responsive if a bidder fails to submit the subcontractor disclosure form by the deadline.

1.7 RIGHT TO REJECT OR WITHDRAW BIDS

- A. The Owner reserves the right to waive minor informalities in the bids. In addition, the Owner may reject any bid proposal not in compliance with prescribed bidding procedures and may reject, for good cause, any and all bid proposals upon finding of the Owner that it is in their interest to do so.
- B. No bidder may withdraw a bid after the hour set for receipt of bids unless thirty (60) days have elapsed, and the Owner has not let a contract.

1.8 INTENT TO AWARD/ PROTEST PERIOD

- A. Subsequent to opening of the bids and determination of a bid within the acceptable project budget, a **Notice of Intent to Award** will be emailed to the qualified low bidder with a copy to all other contractors submitting a bid. Bidders shall have seven (7) calendar days from the Notice of Intent to Award date within which to review the bid files (by appointment), request any clarifications, or submit a written protest. After the expiration of the seven (7) day period and giving due consideration to any protest the owner shall proceed with the formal award of the Contract for Construction.
- B. All award protests must be in writing and either mailed or hand-delivered to: **Clackamas Fire District, 11300 SE Fuller Rd, Milwaukie, OR 97222** and received within the protest period. The Owner shall not consider any written protest not received by this deadline.

1.9 AWARD OF CONTRACT

- A. Award will be based on the sum of the Base Bid.

1.10 PROJECT SCHEDULE

- A. It is a condition of the Bid that all work on this project shall be completed no later than **4 months** from Notice to Proceed, not including any extension in contract time authorized by approved Change Order. The anticipated construction start date is to be **within 14 days of contract execution**. Submission of a Bid shall indicate Bidder agrees to pay as **liquidated damages**, the amount of five hundred dollars (\$150) per calendar day beyond said substantial completion date, one thousand dollars (\$250) per calendar day beyond said final completion deadline, until all work is determined complete.

1.11 PREVAILING WAGE RATES

- A. This project is a public works project. By signing the bid, the bidder agrees to comply with the provisions of ORS 279C.800-870 and are subject to the federal prevailing wage provisions of Davis-Bacon Act 40 U.S.C. 3141.
- B. State of Oregon Bureau of Labor and Industries (BOLI) Prevailing Rate of Wage apply to all work in this project including work performed by Subcontractors.
- C. These wage rates are included in **Section 00 73 43** of the Project Manual. When two different wage rates area listed, the higher of the two shall apply. See supplemental conditions for more information on prevailing wages.

**SECTION 00 11 13
INVITATION TO BID**

- D. All contractors and sub-contractors must be able to provide evidence of a current Public Works Bond.

1.12 ADDENDA

- A. The plan center listed will notify its potential bidders registered of addenda.

END OF DOCUMENT

**SECTION 00 21 00
INSTRUCTIONS TO BIDDERS**

PART 1 GENERAL

1.1 REQUIREMENTS

- A. The Instructions to Bidders, AIA Document A701, 2018 edition, as amended herein, is hereby incorporated into this Project Manual.

1.2 REFERENCE

- A. AIA Document A701, 2018 edition. [See attached]
B. AIA Documents may be purchased from:
1. Oregon: AIA Portland
403 NW 11th Avenue
Portland, OR 97209
Ph: (503) 223-8757
Fx: (503) 220-0254
www.aiaportland.org

1.2 RELATED SECTIONS SPECIFIED ELSEWHERE

- | | | |
|----|--|------------------|
| A. | Supplementary Instructions to Bidders | Section 00 22 13 |
| B. | Bid Form | Section 00 41 00 |
| C. | Bid Security | Section 00 43 13 |
| D. | First Tier Subcontractor Disclosure Form | Section 00 45 21 |
| E. | Contract for Construction | Section 00 52 00 |
| F. | Amendments to Contract for Construction – CDBG | Section 00 53 00 |
| G. | Performance Bond & Payment Bond | Section 00 61 13 |
| H. | General Conditions | Section 00 72 00 |
| I. | Supplementary General Conditions | Section 00 73 00 |
| J. | Supplementary General Conditions – CDBG | Section 00 73 13 |
| K. | Prevailing Wage Rates | Section 00 73 43 |
| L. | State of Oregon – Public Contracting Clauses | Section 00 73 73 |

END OF SECTION

**SECTION 00 41 33
BID FORM - COST-PLUS-FEE (SINGLE-PRIME CONTRACT)**

DOCUMENT 00 41 33 - BID FORM - COST-PLUS-FEE (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Project Name: Clackamas Fire District Training Warehouse
- C. Project Location: 16170 SE 130th Ave, Clackamas, Oregon, 97015.
- D. Owner: Clackamas Fire District.
- E. Owner Project Number: 300025001-2.
- F. Architect: Scott Edwards Architecture, LLP.
- G. Architect Project Number: 24083.

1.2 CERTIFICATIONS AND CONTRACTOR'S FEE

- A. Base Bid, Single-Prime (All Trades) Cost-Plus-Fee Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by Scott Edwards Architecture, LLP and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment, and services necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the Cost of the Work as defined in the Contract Documents, plus the following Contractor's Fee of:
 - 1. _____ Dollars
(\$_____).
 - 2. _____ percent (___%) of the Cost of the Work.

1.3 GUARANTEED MAXIMUM PRICE

- A. The undersigned Bidder will guarantee that the Contract Sum, consisting of the Cost of the Work plus the Contractor's Fee, referred to in the Contract Documents as the Guaranteed Maximum Price, shall not exceed the following:
 - 1. _____ Dollars
(\$_____).

1.4 BID GUARANTEE

- A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within **10** days after a written Notice of Award, if offered within **60** days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5%) of the Base Bid amount above:
 - 1. _____ Dollars
(\$_____).
- B. In the event Owner does not offer a Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

1.5 SUBCONTRACTORS AND SUPPLIERS

- A. The following companies shall execute subcontracts for the portions of the Work indicated:
 - 1. Plumbing_Work: _____.
 - 2. HVAC_Work: _____.
 - 3. Electrical_Work: _____.

**SECTION 00 41 33
BID FORM - COST-PLUS-FEE (SINGLE-PRIME CONTRACT)**

1.6 TIME OF COMPLETION

A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by the owner and shall fully complete the Work within 120 calendar days.

1.7 ACKNOWLEDGEMENT OF ADDENDA

A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated _____.
2. Addendum No. 2, dated _____.
3. Addendum No. 3, dated _____.
4. Addendum No. 4, dated _____.

1.8 BID SUPPLEMENTS

A. The following supplements are a part of this Bid Form and are attached hereto:

1. Bid Form Supplement - Alternates.
2. Bid Form Supplement - Unit Prices.
3. Bid Form Supplement - Allowances.
4. Bid Form Supplement - Bid Bond Form (AIA Document A310-2010).

1.9 CONTRACTOR'S LICENSE

A. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in the City of Cornelius, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

1.10 SUBMISSION OF BID

- A. Respectfully submitted this ____ day of _____, 2023.
- B. Submitted By: _____ (Name of bidding firm or corporation).
- C. Authorized Signature: _____ (Handwritten signature).
- D. Signed By: _____ (Type or print name).
- E. Title: _____ (Owner/Partner/President/Vice President).
- F. Witness By: _____ (Handwritten signature).
- G. Attest: _____ (Handwritten signature).
- H. By: _____ (Type or print name).
- I. Title: _____ (Corporate Secretary or Assistant Secretary).
- J. Street Address: _____.
- K. City, State, Zip _____.
- L. Phone: _____.
- M. License No.: _____.
- N. Federal ID No.: _____ (Affix Corporate Seal Here).

END OF DOCUMENT

**SECTION 00 43 13
BID SECURITY FORMS**

SECTION 00 43 13 - BID SECURITY FORMS

1.1 REQUIREMENTS

- A. A completed bid bond form is required to be attached to the Bid Form.

1.2 REFERENCE

- A. AIA Document A310-2010 "Bid Bond" is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.
- B. AIA Documents may be purchased from:
1. Oregon: AIA Portland
403 NW 11th Avenue
Portland, OR 97209
Ph: (503) 223-8757
Fx: (503) 220-0254
www.aiaportland.org

1.3 RELATED SECTIONS SPECIFIED ELSEWHERE

- | | |
|---|------------------|
| A. Supplementary Instructions to Bidders | Section 00 22 00 |
| B. Bid Form | Section 00 41 00 |
| C. Bid Bond | Section 00 43 13 |
| D. Qualification and Reference Form | Section 00 45 13 |
| E. First Tier Subcontractor Disclosure Form | Section 00 45 21 |
| F. Contract for Construction | Section 00 52 00 |
| G. Performance Bond & Payment Bond | Section 00 61 13 |
| H. General Conditions | Section 00 72 00 |
| I. Supplementary General Conditions | Section 00 73 00 |
| J. Prevailing Wage Rates | Section 00 73 43 |
| K. State of Oregon – Public Contracting Clauses | Section 00 73 73 |

END OF DOCUMENT

**SECTION 00 43 23
ALTERNATES FORM**

SECTION 00 43 23 - ALTERNATES FORM

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Project Name: Clackamas Fire District Training Warehouse.
- C. Project Location: 16170 SE 130th Ave, Clackamas, Oregon, 97015.
- D. Owner: Clackamas Fire District.
- E. Owner Project Number: 300025001-2.
- F. Architect: Scott Edwards Architecture, LLP.
- G. Architect Project Number: 24083.

1.2 BID FORM SUPPLEMENT

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

1.3 DESCRIPTION

- A. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular alternates are accepted by Owner. Amounts listed for each alternate include costs of related coordination, modification, or adjustment.
 - 1. Cost-Plus-Fee Contract: Alternate price given below includes adjustment to Contractor's Fee.
- B. If the alternate does not affect the Contract Sum, the Bidder shall indicate "NO CHANGE."
- C. If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."
- D. The Bidder shall be responsible for determining from the Contract Documents the affects of each alternate on the Contract Time and the Contract Sum.
- E. Owner reserves the right to accept or reject any alternate, in any order, and to award or amend the Contract accordingly within [60] days of the Notice of Award unless otherwise indicated in the Contract Documents.
- F. Acceptance or non-acceptance of any alternates by the Owner shall have no effect on the Contract Time unless the "Schedule of Alternates" Article below provides a formatted space for the adjustment of the Contract Time.

1.4 SCHEDULE OF ALTERNATES

- A. Alternate No. <Insert number>: <Insert title of alternate>:
 - 1. ADD ___ DEDUCT ___ NO CHANGE ___ NOT APPLICABLE ___.
 - 2. _____ Dollars
(\$_____).
 - 3. ADD ___ DEDUCT ___ calendar days to adjust the Contract Time for this alternate.

1.5 SUBMISSION OF BID SUPPLEMENT

- A. Respectfully submitted this ___ day of _____, <Insert year>.
- B. Submitted By: _____ (Insert name of bidding firm or corporation).
- C. Authorized Signature: _____ (Handwritten signature).
- D. Signed By: _____ (Type or print name).
- E. Title: _____ (Owner/Partner/President/Vice President).

END OF DOCUMENT

**SECTION 00 43 25
PRE-BID SUBSTITUTION REQUEST FORM**

All pre-bid substitution requests shall be submitted in either PDF format via email – **or-** by hard copy via mail/delivery to the General Contractor first for review.

If deemed acceptable, General Contractor shall submit to the Architect for review to the address listed below:

TO: **SCOTT EDWARDS ARCHITECTURE, LLP**
2525 E Burnside Street
Portland, Oregon 97214
Email: bdole@seallp.com

PROJECT: **Clackamas Fire District Training Warehouse – Clackamas, OR**

We hereby submit for your consideration the Product described below as a substitute for the specified product indicated: (See also Section 01 25 00 for additional information)

1. SPECIFIED PRODUCT:

Name: _____

Section: _____ Paragraph: _____

2. PROPOSED SUBSTITUTION:

a. Brand Name: _____

b. Model/Catalog No: _____

c. Manufacturer: _____

d. _____

[address/city/state/zip code]

[phone]

e. Nearest Distributor: _____

[address/city/state/zip code]

[phone]

f. Substitute product affects adjacent Work in the following way:

3. SUPPORTING DATA:

**SECTION 00 43 25
PRE-BID SUBSTITUTION REQUEST FORM**

- a. Attached data included product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request: applicable portions of the data are clearly identified.
- b. Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

4. **CERTIFICATION**

The undersigned certifies that the following paragraphs, unless modified on attachments, are correct:

- a. The proposed substitution does not affect dimensions shown on Drawings.
- b. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.
- c. The proposed substitution will have no adverse affect on the other trades, the construction schedule, or specified warranty requirements.
- d. Maintenance and service parts will be locally available for the proposed substitution.
- e. **The proposed substitution meets or exceeds the requirements established by the referenced specifications and/or the product specified therein in all respects except at listed below:**

5. **SUBMITTED BY:**

Firm: _____

[address / city / state / zip code]

Phone: [_____] Fax: [_____]

By: _____ Title: _____

[please type or print]

Signature: _____

6. **ACCEPTANCE/REJECTION:**

Acceptable substitution items will be covered by an Addendum issued to all bidders.

7. **ARCHITECT'S ACTION:**

The following is for use by the Architect:

- | | |
|---------------------------------------|---|
| <input type="checkbox"/> Accepted | <input type="checkbox"/> Accepted with exceptions as noted. |
| <input type="checkbox"/> Not Accepted | <input type="checkbox"/> Received after deadline. |

Remarks: _____

By: _____ Date: _____

**SECTION 00 43 25
PRE-BID SUBSTITUTION REQUEST FORM**

For: **Scott | Edwards Architecture, LLP**

END OF SECTION

**SECTION 00 43 73
PROPOSED SCHEDULE OF VALUES FORM**

DOCUMENT 00 43 73 - PROPOSED SCHEDULE OF VALUES FORM

1.1 REQUIREMENTS

- A. A completed Proposed Schedule of Values form is required to be attached to the Bid Form.

1.2 PROPOSED SCHEDULE OF VALUES FORM

- A. Proposed Schedule of Values Form: Provide a breakdown of the bid amount, including alternates, in enough detail to facilitate continued evaluation of bid. Coordinate with the Project Manual table of contents. Provide multiple line items for principal material and subcontract amounts in excess of five (5) percent of the Contract Sum.

- B. Arrange schedule of values using [AIA Document G703-1992] Continuation Sheet.

- C. AIA Documents may be purchased from:

1. Oregon: AIA Portland
403 NW 11th Avenue
Portland, OR 97209
Ph: (503) 223-8757
Fx: (503) 220-0254
www.aiaportland.org

END OF DOCUMENT

**SECTION 00 43 93
BID SUBMITTAL CHECKLIST**

SECTION 00 43 93 - BID SUBMITTAL CHECKLIST

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Prime Contract: _____.
- C. Project Name: **Clackamas Fire District Training Warehouse.**
- D. Project Location: 16170 SE 130th Ave, Clackamas, OR 97015.
- E. Owner: Clackamas Fire District.
- F. Owner Project Number: 300025001-2.
- G. Architect: Scott Edwards Architecture, LLP.
- H. Architect Project Number: 24083.

1.2 BIDDER'S CHECKLIST

- A. In an effort to assist the Bidder in properly completing all documentation required, the following checklist is provided for the Bidder's convenience. The Bidder is solely responsible for verifying compliance with bid submittal requirements.
- B. Attach this completed checklist to the outside of the Submittal envelope.
 - 1. Used the Bid Form provided in the Project Manual.
 - 2. Prepared the Bid Form as required by the Instructions to Bidders.
 - 3. Indicated on the Bid Form the Addenda received.
 - 4. Attached to the Bid Form: Bid Supplement Form - Allowances.
 - 5. Attached to the Bid Form: Bid Supplement Form - Alternates.
 - 6. Attached to the Bid Form: Proposed Schedule of Values Form.
 - 7. Attached to the Bid Form: First Tier Contractor Form.
 - 8. Attached to the Bid Form: Non-Collusion Affidavit.
 - 9. Attached to the Bid Form: Bid Bond OR a certified check for the amount required.
 - 10. Bid envelope shows name and address of the Bidder.
 - 11. Bid envelope shows the Bidder's Contractor's License Number.
 - 12. Bid envelope shows name of Project being bid.
 - 13. Bid envelope shows name of Prime Contract being bid, if applicable.
 - 14. Bid envelope shows time and day of Bid Opening.
 - 15. Verified that the Bidder can provide executed Performance Bond and Labor and Material Bond.
 - 16. Verified that the Bidder can provide Certificates of Insurance in the amounts indicated.

END OF DOCUMENT

SECTION 00 45 21
FIRST TIER SUBCONTRACTOR DISCLOSURE FORM

The Owner, pursuant to ORS 279C.370, must reject a Bid if the Bidder fails to disclose information about certain first-tier subcontractors when the contract value for a Public Improvement is greater than \$100,000. Within two (2) hours of the date and time of the deadline when bids are due, the Bidders shall submit to the City a disclosure of any first-tier subcontractors whose contract value is equal to or greater than: a) five percent (5%) of the total Project bid, but at least Fifteen Thousand Dollars (\$15,000); or b) Three Hundred Fifty Thousand Dollars (\$350,000), regardless of the percentage of the total Project bid.

The Bidder must disclose the required information about that subcontract either in its bid submission or within two hours after bid closing, by completing the attached form.

If the Bidder will not be using any subcontractors that are subject to the above disclosure requirements, the Bidder is required to indicate “*NONE*” on the attached form.

Compliance with the disclosure and submittal requirements of ORS 279C.370 and this rule is a matter of responsiveness. Bids that are submitted by bid closing, but for which the disclosure submittal has not been made by the specified deadline, are not responsive and shall not be considered for contract award.

Substitution of affected first-tier subcontractors shall be made only in accordance with ORS 279C.585. Agencies do not have a statutory role or duty to review, approve, or resolve disputes concerning such substitutions. See ORS 279C.585 and 279C.590 regarding complaints to the Construction Contractors Board on improper substitution.

**SECTION 00 45 21
FIRST TIER SUBCONTRACTOR DISCLOSURE FORM**

Project Name: Clackamas Fire District Training Center Bid #: _____

Bid Closing Date & Time: **Thursday February 6, 2025 @ 2:00 PM** LOCAL TIME

Required First Tier Subcontractor Deadline: **Thursday February 6, 2025 @ 4:00 PM** LOCAL TIME

Form Submitted by (bidder name): _____

Contact Name: _____ Phone Number: _____

This form must be submitted at the location specified in the Invitation to Bid on the advertised bid closing date and within two working hours after the advertised bid closing time. Failure to submit this form by the disclosure deadline will result in a nonresponsive bid. A nonresponsive bid will not be considered for award.

List below the name of each subcontractor that will be furnishing labor or will be furnishing labor and materials and that is required to be disclosed, the category of work that the subcontractor will be performing and the dollar value of the subcontract. Enter "NONE" if there are no subcontractors that need to be disclosed.

Firm Name	Category of Work to be Performed
Address	CCB Number
City, State, Zip	Subcontract Amount
Firm Name	Category of Work to be Performed
Address	CCB Number
City, State, Zip	Subcontract Amount
Firm Name	Category of Work to be Performed
Address	CCB Number
City, State, Zip	Subcontract Amount

Add additional pages if necessary.

**SECTION 00 45 23
NON-COLLUSION AFFIDAVIT**

I state that the above-named firm understands and acknowledges that the above representations are material and important, and will be relied on by the City of Cornelius in awarding the Contract(s) for which this bid is submitted. I understand, and my firm understands, that any misstatement in this affidavit is and shall be treated as fraudulent concealment from the City of Cornelius of the true facts relating to this submission of bids for this Contract.

I make these statements under penalty of perjury.

Signature

Print Name

Title

STATE OF OREGON)
) ss
County of _____)

Sworn to and subscribed before me this _____ day of _____, 2018.

Notary Public for Oregon

**SECTION 00 45 23
NON-COLLUSION AFFIDAVIT**

INSTRUCTIONS OF NON-COLLUSION AFFIDAVIT

1. This Non-Collusion Affidavit ("Affidavit") is material to any contract awarded pursuant to this bid. According to the Oregon Public Contracts and Purchasing Laws, a public contracting agency may reject any or all bids on a finding of the agency that it is in the public interest to do so. ORS 279C.395. This agency finds that it is in the public interest to require the completion of this Affidavit by potential contractors.
2. This Affidavit must be executed by the member, officer, or employee of the Bidder who makes the final decision on prices and the amount quoted in the bid.
3. Bid rigging and other efforts to restrain competition, and the making of false sworn statements in connection with the submission of bids, are unlawful and may be subject to criminal prosecution. The person who signs the Affidavit should examine it carefully before signing and assure himself/herself that each statement is true and accurate, making diligent inquiry, as necessary, of all other persons employed by or associated with the Bidder with responsibilities for the preparation, approval, or submission of the bid.
4. In the case of a bid submitted by a joint venture, each party to the venture must be identified in the Bid Documents, and an Affidavit must be submitted separately on behalf of each party.
5. The term "complementary bid," as used in the Affidavit, has the meaning commonly associated with that term in the bidding process, and includes the knowing submission of bids higher than the bid of another firm, any intentionally high or non-competitive bid, and any other form of bid submitted for the purpose of giving a false appearance of competition.
6. Failure to file an Affidavit in compliance with these instructions will result in disqualification of the bid.
7. A completed, signed, and notarized Affidavit must be submitted with the bid before the bid opening.

SECTION 00 52 00
CONTRACT FOR CONSTRUCTION

PART 1 GENERAL

1.1 REQUIREMENTS

- A. The Contract for Construction, Standard Form Agreement Between Owner and Contractor, AIA Document A101, 2017 Edition, is hereby incorporated into this Project Manual.

1.2 REFERENCE

- A. Standard Form Agreement Between Owner and Contractor, AIA Document A101, 2017 Edition. [Attached herewith]
- B. AIA Documents may be purchased from:
 - 1. Oregon: AIA Portland
 403 NW 11th Avenue
 Portland, OR 97209
 Ph: (503) 223-8757
 www.aiaportland.org

END OF SECTION

SECTION 00 61 13
PERFORMANCE BOND AND PAYMENT BOND

PART 1 GENERAL

1.1 REQUIREMENTS

- A. The Performance and Payment Bond, AIA Document A312, 2010 edition, is hereby incorporated into this Project Manual by reference.

1.2 REFERENCE

- A. AIA Document A312, 2010 edition. [Attached by reference]
B. AIA Documents may be purchased from:
1. Oregon: AIA Portland
403 NW 11th Avenue
Portland, OR 97209
Ph: (503) 223-8757
Fx: (503) 220-0254
www.aiaportland.org

1.3 RELATED SECTIONS SPECIFIED ELSEWHERE

- | | | |
|----|--|------------------|
| A. | Instructions to Bidders | Section 00 21 00 |
| B. | Supplementary Instructions to Bidders | Section 00 22 00 |
| C. | Bid Form | Section 00 41 00 |
| D. | Bid Bond | Section 00 43 13 |
| E. | First Tier Subcontractor Disclosure Form | Section 00 45 21 |
| F. | Contract for Construction | Section 00 52 00 |
| G. | General Conditions | Section 00 72 00 |
| H. | Supplementary General Conditions | Section 00 73 00 |
| I. | Supplementary General Conditions – CDBG | Section 00 73 13 |
| J. | Prevailing Wage Rates | Section 00 73 43 |
| K. | State of Oregon – Public Contracting Clauses | Section 00 73 73 |

END OF SECTION

**SECTION 00 72 00
GENERAL CONDITIONS**

PART 1 GENERAL

1.1 REQUIREMENTS

- A. The General Conditions, AIA Document A201, 2017 edition, is hereby incorporated into this Project Manual.

1.2 REFERENCE

- A. AIA Document A201, 2017 edition. [Attached herewith]
- B. AIA Documents may be purchased from
 - 1. Oregon: AIA Portland
 403 NW 11th Avenue
 Portland, OR 97209
 Ph: (503) 223-8757
 www.aiaportland.org

END OF SECTION

**SECTION 00 73 13
SUPPLEMENTARY GENERAL CONDITIONS**

PART 1 GENERAL

1.1 REQUIREMENTS

A. The following conditions and requirements are in addition to the “General Conditions of the Contract for Construction”, AIA Document A201 and the “Standard Form of Agreement Between Owner and Contractor”, AIA Document A101, including all modifications contained in this Project Manual.

1. Davis Bacon Compliance Checklist

3. David Bacon Labor Standards Guide

END OF SECTION

**SECTION 00 73 43
PREVAILING WAGE RATES**

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Federal Davis Bacon Wage Rate Standards **and** State of Oregon Bureau of Labor and Industries (BOLI) Prevailing Rate of Wage **both** apply to all work on this project including work performed by Subcontractors. The reporting and review standards are set by State of Oregon Bureau of Labor and Industries BOLI standards. Contractors must comply with all requirements currently published by both agencies relative to minimum wage rates and labor standards. In the event conflicting requirements are discovered between wage rates published by each agency, the higher of the conflicting rates shall govern and be deemed part of the Contractor's Bid.
- B. BOLI Fee: The Owner shall be responsible to pay a fee to the Bureau of Labor and Industries pursuant to the provisions of ORS 279C.825. The fee is one-tenth of one percent of the price of this Contract, but not less than \$250 nor more than \$7,500 regardless of the Contract price.
 - Contact: Contract Fee Section
 Prevailing Wage Rate Unit
 Bureau of Labor and Industries
 800 NE Oregon Street, #32
 Portland, OR 97232

1.2 REFERENCE

- A. **Davis Bacon:** The enclosed edition of wage rates was current as of the date of this printing; Effective as of **January 1, 2022**. The latest edition of the DAVIS BACON portion, as of 10 days before the Bid Date, will be the edition required for this Bid, and will be sent as an addendum to all registered plan holders. The latest version can be obtained from the Federal website <http://www.wdol.gov/dba.aspx#0> Click on "Selecting DBA WDs", then search by "State: **Oregon**", "County: **Clackamas County**" and "Construction Type: **Building**".
- B. **BOLI:** The State of Oregon Bureau of Labor and Industries, Prevailing Wage Rates for Public Works Contracts in Oregon, effective **January 1, 2022**. Electronic copies of this document can be obtained at the following website:

http://egov.oregon.gov/boli/WHD/PWR/pages/pwr_state.aspx

1.3 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- | | | |
|----|--|------------------|
| A. | Instructions to Bidders | Section 00 21 00 |
| B. | Supplementary Instructions to Bidders | Section 00 22 00 |
| C. | Bid Form | Section 00 41 00 |
| D. | Bid Bond | Section 00 43 13 |
| E. | First Tier Subcontractor Disclosure Form | Section 00 45 21 |
| F. | Contract for Construction | Section 00 52 00 |
| G. | Performance Bond & Payment Bond | Section 00 61 13 |
| H. | General Conditions | Section 00 72 00 |
| I. | Supplementary General Conditions | Section 00 73 00 |
| J. | State of Oregon – Public Contracting Clauses | Section 00 73 73 |

END OF SECTION

SECTION 00 73 73
State of Oregon - PUBLIC CONTRACTING CLAUSES

PART 1 GENERAL

1.1 REQUIREMENTS

- A. This is a Public Improvement Project utilizing public funds and is subject to all regulations of the State of Oregon Public Contracting Code, ORS 279A and 279C unless specifically amended by the General and Supplementary Conditions for the Project.
1. For convenience, special attention is herein brought to the following public contracting clauses:
- a. ORS 279C.800 – 870: This project is subject to Prevailing Wage Rates promulgated by the Oregon Bureau of Labor and Industries (BOLI). See also Section 00826 of the Project Manual.
 - b. ORS 279C.845: Contractors are required to submit certified payroll reports each month. Contractors failing to submit the required reports will be subject to an additional withholding, above any other retainage promulgated by ORS 279C.555, of 25 percent of any amount earned. Once the certified payroll reports have been submitted, the public agency must pay the 25 percent withheld within 14 days per ORS 279C.845 (7).
 - c. ORS 279C.836: Requires that all independent contractors working on qualifying public works projects with a contract price that exceeds \$100,000, must obtain and file with the Oregon Construction Contractors Board (CCB) a public works bond with a corporate surety authorized to do business in Oregon for the amount of \$30,000 before starting work on a contract or subcontract for a public works project.
 - d. House Bill 2895 (1999): Contractors currently listed by the Oregon Construction Contractors Board (CCB) as 'not qualified to hold public contracts' are not eligible to work on this project.
 - e. Public Works Bond: In accordance with ORS 279C.830(3) and before starting work on the Project, Contractor shall file a \$30,000 Public Works Bond with the Oregon Construction Contractors Board. Contractor shall include a requirement in every subcontract which requires the subcontractor to file a \$30,000 Public Works Bond with the Oregon Construction Contractors Board in accordance with ORS 279C.830(3)(b) and before starting work on the Project.
 - f. ORS 279C.515 / OAR 839-025-0020(2)(a): If the Contractor fails to pay for labor and services as required by this Contract, the Owner can pay for them directly and withhold these amounts from payments to the Contractor.
 - g. The Contractor must pay daily, weekly, weekend and holiday overtime as required by ORS 279C.540 / OAR 839-025-0020(2)(b).
 - h. The Contractor must give written notice to workers of the number of hours per day and days per week they may be required to work per OAR 839-025-0020(2)(c).
 - i. The Contractor must make prompt payment for all medical services for which the contractor has agreed to pay, and for all amounts for which the contractor collects or deducts from worker's wages per ORS 279C.530 / OAR 839-025-0020(3).
- B. Contractor / Subcontractor Form:
Pursuant to Section 00 72 00, General Conditions, each subcontract between General Contractor and Sub-contractor or Sub-contractor and lower tier sub-contractors shall contain the attached "Addendum to Contract between Contractor and Subcontractor. [attached]

SECTION 00 73 73
State of Oregon - PUBLIC CONTRACTING CLAUSES

1.2 REFERENCE

- A. State of Oregon Revised Statutes (ORS) - 2021
 - 1. Chapters 279, 279A and 279C.; available on-line at:
 - a. <http://www.leg.state.or.us/ors/>

1.3 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- | | | |
|----|--|------------------|
| A. | Instructions to Bidders | Section 00 21 00 |
| B. | Supplementary Instructions to Bidders | Section 00 22 00 |
| C. | Bid Form | Section 00 41 00 |
| D. | Bid Bond | Section 00 43 13 |
| E. | First Tier Subcontractor Disclosure Form | Section 00 45 21 |
| F. | Contract for Construction | Section 00 52 00 |
| G. | Performance Bond & Payment Bond | Section 00 61 13 |
| H. | General Conditions | Section 00 72 00 |
| I. | Supplementary General Conditions | Section 00 73 00 |
| J. | Prevailing Wage Rates | Section 00 73 43 |

END OF SECTION

ADDENDUM TO CONTRACT BETWEEN CONTRACTOR AND SUBCONTRACTOR

Pursuant to the General Conditions of the Contract for Construction - Attachment 'A', Clause A.2; each subcontract between General Contractor and Sub-contractor or Sub-Contractor and lower tier sub-contractors shall have attached thereto a fully executed copy of this addendum.

Contract

Date: _____

Contractor: _____

Address: _____

Project: **Clackamas Fire District Training Warehouse**
16170 SE 130th Ave, Clackamas, OR 97015

The parties, having executed a contract for: _____ in the amount of \$ _____ in the construction of the above-identified project acknowledge and agree that:

1. This is a Public Improvement Project utilizing public funds and is subject to all regulations of the State of Oregon Revised Statutes (ORS) Public Contracting Code, ORS 279A and 279C. The Contractor shall comply with all regulations contained therein unless specifically amended by the General and Supplementary Conditions for the Project.
2. For convenience, special attention is herein brought to the following public contracting clauses:
 - a. ORS 279C.800 – 870: This project is subject to Prevailing Wage Rates promulgated by the Oregon Bureau of Labor and Industries (BOLI). See also Sections 00 73 43 and 00 73 73 of the Project Manual.
 - b. ORS 279C.845: Contractors are required to submit certified payroll reports each month. Contractors failing to submit the required reports will be subject to an additional withholding, above any other retainage promulgated by ORS 279C.555, of 25 percent of any amount earned. Once the certified payroll reports have been submitted, the public agency must pay the 25 percent withheld within 14 days per ORS 279C.845 (7).
 - c. ORS 279C.836: Requires that all independent contractors working on qualifying public works projects with a contract price that exceeds \$100,000, must obtain and file with the Oregon Construction Contractors Board (CCB) a public works bond with a corporate surety authorized to do business in Oregon for the amount of \$30,000 before starting work on a contract or subcontract for a public works project.

The Subcontractor certifies that:

- a. The subcontractor is an independent contractor in compliance with ORS Chapter 701;
- b. The subcontractor is currently registered with the Oregon Construction Contractors Board (CCB) in a class appropriate for the work to be performed under this subcontract and;
- c. Pursuant to Oregon House Bill 2895 (1999): the undersigned subcontractor, or any of its principals, are not listed by the Oregon Construction Contractors Board (CCB) as 'not qualified to hold public contracts'.

Contractor Signature:

Subcontractor Signature:

(Title/Date)

(Title/Date)

**SECTION 01 10 00
SUMMARY**

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General requirements.
 - 2. Project information.
 - 3. Work covered by Contract Documents.
 - 4. Owner-furnished/Contractor-installed (OFCI) products.
 - 5. Contractor's use of site and premises.
 - 6. Coordination with occupants (if applicable).
 - 7. Work restrictions.
 - 8. Specification and Drawing conventions.
- B. Related Requirements:
 - 1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
 - 2. Section 01 73 00 "Execution" for coordination of Owner-installed products.

1.2 PROJECT INFORMATION

- A. Project Identification: SEA Project Number 24083 Clackamas Fire Training Warehouse.
 - 1. Project Location: 16170 SE 130th Ave., Clackamas, OR 97015.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
 - 1. Renovation of existing 1-Story portion of the Clackamas Fire District Training Warehouse.

1.4 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
 - 1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
 - 2. Provide for delivery of Owner-furnished products to Project site.
 - 3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
 - 4. Obtain manufacturer's inspections, service, and warranties.
 - 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
 - 1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
 - 2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
 - 3. Receive, unload, handle, store, protect, and install Owner-furnished products.
 - 4. Make building services connections for Owner-furnished products.
 - 5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
 - 6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFCI) Products:
 - 1. See Drawings for complete list of products.

**SECTION 01 10 00
SUMMARY**

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
 - 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Weekend Hours: Limit work to between 8:00 a.m. to 5:00 p.m., unless otherwise indicated.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.

**SECTION 01 10 00
SUMMARY**

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

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 21 00
ALLOWANCES**

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Quantity allowances.
 - 3. Contingency allowances.
- C. Related Requirements:
 - 1. Section 01 26 00 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 01 40 00 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.2 DEFINITIONS

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

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

**SECTION 01 21 00
ALLOWANCES**

1.7 QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.9 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

**SECTION 01 21 00
ALLOWANCES**

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

- A. See Drawings for allowance items and details.
- B. See individual specification sections in Divisions 2 through 32 for allowance items and details.

END OF SECTION

**SECTION 01 25 00
SUBSTITUTION PROCEDURES**

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 01 21 00 "Allowances" for products selected under an allowance.
 - 2. Section 01 23 00 "Alternates" for products selected under an alternate.
 - 3. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual at the end of this Section.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES with applicable state amendments.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's

**SECTION 01 25 00
SUBSTITUTION PROCEDURES**

letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

- k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include

**SECTION 01 25 00
SUBSTITUTION PROCEDURES**

- compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES” FOR REQUIREMENTS AND ADDITIONAL INFORMATION.

f. Project Examples: (List, or attach project list, with name of architect and contractor)

f. Substitute product affects adjacent Work in the following way:

g. Reason for Substitution: _____

For substitutions after bidding:

h. Savings to Owner for accepting substitution: _____

i. Proposed substitution changes Contract Time: No Yes:
Add / Deduct _____
days

3. SUPPORTING DATA:

- a. Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.
- b. Attached data also clearly identifies and includes description of changes to Contract Documents which proposed substitution will require for its proper installation.
- c. All other items required for evaluation and validation according to Section 01 25 00.

4. CERTIFICATION

The undersigned certifies that the following paragraphs, unless modified on attachments, are complete and correct:

- a. The proposed substitution does not affect dimensions shown on Drawings.
- b. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.
- c. The proposed substitution will have no adverse affect on the other trades, the construction schedule, or specified warranty requirements.
- d. Maintenance and service parts will be locally available for the proposed substitution.
- e. **The proposed substitution meets or exceeds the requirements established by the referenced specifications and/or the product specified therein in all respects except as listed below:**

SECTION 01 25 00
SUBSTITUTION PROCEDURES” FOR REQUIREMENTS AND ADDITIONAL INFORMATION.

5. SUBMITTED BY:
Firm: _____

_____ [address / city / state / zip code]

_____ [phone] _____ [email]

By: _____ Title: _____
[please type or print]

Signature: _____
[Sign and date]

6. ACCEPTANCE/REJECTION:
Approved substitutions will be issued via an Addendum to all bidders (pre-bid only).

7. ARCHITECT'S ACTION: (The following is for use by the Architect):

- Substitution approved
- Substitution approved as noted
- Substitution Rejected – Use Specified Item
- Substitution Rejected – Received too late – Use Specified Item

Remarks: _____

By: _____ Date: _____

For: **Scott Edwards Architecture, LLP**

END OF FORM

**SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES**

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 01 21 00 "Allowances" for procedural requirements governing the handling and processing of allowances.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, in a form designated by the Architect, and signed by the Architect.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

**SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES**

6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.4 ADMINISTRATIVE CHANGE ORDERS

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

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 29 00
PAYMENT PROCEDURES**

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 21 00 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 - 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 01 10 00 "Summary."
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.

**SECTION 01 29 00
PAYMENT PROCEDURES**

- e. Name of supplier.
- f. Change Orders (numbers) that affect value.
- g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
- 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
- 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
- 7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
- 8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
- 9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
- 12. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the 10th day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 - 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.

**SECTION 01 29 00
PAYMENT PROCEDURES**

2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.

**SECTION 01 29 00
PAYMENT PROCEDURES**

14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 77 00 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 10. Final liquidated damages settlement statement (if applicable).
 11. Proof that taxes, fees, and similar obligations are paid.
 12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION**

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. RFIs.
 - 3. Digital project management procedures.
 - 4. Web-based Project management software package.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and, if applicable, Owner activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Name of Architect.
 3. Architect's Project number.
 4. Date.
 5. Name of Contractor.
 6. RFI number, numbered sequentially.
 7. RFI subject. (Limit each RFI to one issue or question)
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 1. Attachments shall be electronic files in PDF format.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager (if applicable) will review each RFI, determine action required, and respond. Allow fourteen (14) calendar days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following calendar day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

- e. Requests for adjustments in the Contract Time or the Contract Sum.
- f. Requests for interpretation of Architect's actions on submittals.
- g. Incomplete RFIs or inaccurately prepared RFIs.
- 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
- 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 5 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect (and Construction Manager if applicable).
 - 4. RFI number, including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's and Construction Manager's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of ten working days prior to meeting.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager (if applicable), and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 - 1. Attendees: Authorized representatives of Owner, Construction Manager (if applicable), Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

- j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises and/or existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager (if applicable) of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals. Architect will attend Progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of Proposal Requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

**SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION**

END OF SECTION

**SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION**

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
 - 2. Section 01 40 00 "Quality Requirements" for schedule of tests and inspections.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
 - 3. Two paper copies, of sufficient size to display entire period or schedule, as required.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.

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CONSTRUCTION PROGRESS DOCUMENTATION**

- D. Daily Construction Reports: Submit at monthly intervals.
- E. Material Location Reports: Submit at monthly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Unusual Event Reports: Submit at time of unusual event.

1.4 COORDINATION

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

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 - 3. Procurement Activities: Include procurement process activities for long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 4. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - 5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 - 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing (if applicable): Arrange list of activities on schedule by phase.
 - 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 4. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction (if applicable).

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CONSTRUCTION PROGRESS DOCUMENTATION**

- b. Limitations of continued occupancies (if applicable).
 - c. Uninterruptible services.
 - d. Use-of-premises restrictions.
 - e. Environmental control.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- F. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
- 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Final Completion percentage for each activity.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
- 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
- 1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
- 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.

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- d. Delivery.
- e. Fabrication.
- f. Utility interruptions.
- g. Installation.
- h. Work by Owner that may affect or be affected by Contractor's activities.
- i. Testing and inspection.
- j. Commissioning.
- k. Punch list and Final Completion.
- l. Activities occurring following Final Completion.
- 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
- 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
- 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).
- F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.

1.7 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Testing and inspection.

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8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. Construction Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
 - 4. Final Completion construction photographs.
- B. Related Requirements:
 - 1. Section 01 77 00 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.2 INFORMATIONAL SUBMITTALS

- A. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.3 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time from camera.
- D. File Names: Name media files with date and sequential numbering suffix.

1.4 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take minimum of 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take minimum of 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

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PHOTOGRAPHIC DOCUMENTATION

1. Underground utilities.
 2. Underslab services.
 3. Piping.
 4. Electrical conduit.
 5. Waterproofing and weather-resistant barriers.
 6. Other conditions identified by the Architect.
- D. Periodic Construction Photographs: Take minimum of 50 photographs monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take minimum of 50 photographs after date of Substantial Completion for submission as Project Record Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
 - 3. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 01 32 33 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
 - 5. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 6. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 7. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 9. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect or Architect's consultants and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 - 3. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.

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SUBMITTAL PROCEDURES**

- d. Name of subcontractor.
- e. Description of the Work covered.
- f. Scheduled date for Architect's final release or approval.
- g. Scheduled dates for purchasing.
- h. Scheduled date of fabrication.
- i. Scheduled dates for installation.
- j. Activity or event number.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Architect.
 - 4. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 - 5. Category and type of submittal.
 - 6. Submittal purpose and description.
 - 7. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 - 8. Drawing number and detail references, as appropriate.
 - 9. Indication of full or partial submittal.
 - 10. Location(s) where product is to be installed, as appropriate.
 - 11. Other necessary identification.
 - 12. Remarks.
 - 13. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time

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SUBMITTAL PROCEDURES

will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 calendar days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts. Submit physical color charts when directed by Architect.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.

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- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

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SUBMITTAL PROCEDURES**

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

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:
 - a. No Exceptions Taken: Architect does not take exception to any information provided in the submittal. The submittal conforms to requirements of the Contract Documents.
 - b. Exceptions as Noted: Architect has taken exception to some information provided in the submittal and has noted corrections required to be made. The submittal, with corrections noted, conforms to requirements of the Contract Documents.
 - c. Rejected / Resubmit: Architect has reviewed the submittal and taken exception to one or more items in the submittal that require correction. The submittal does not conform to requirements of the Contract Documents, is rejected and shall be revised and resubmitted.
 - d. See Comments: The Architect may provide comments as appropriate to any submittal that is returned with "No Exceptions Taken", "Exceptions as Noted" or "Rejected / Resubmit".
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 35 16
ALTERATION PROJECT PROCEDURES**

SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep an element or detail secure and intact.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 COORDINATION

- A. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.
 - 1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed.

1.5 INFORMATIONAL SUBMITTALS

- A. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.

1.6 QUALITY ASSURANCE

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

SECTION 01 35 16
ALTERATION PROJECT PROCEDURES

B. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials:

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

B. Salvaged Materials for Reinstallation:

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

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

D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
2. Secure stored materials to protect from theft.
3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.

E. Storage Space:

1. Owner will arrange for limited on-site location(s) for free storage of salvaged material. This storage space includes security and climate control for stored material.
2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.8 FIELD CONDITIONS

A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of preconstruction photographs.

1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."

B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

C. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.

SECTION 01 35 16
ALTERATION PROJECT PROCEDURES

1. Use only proven protection methods, appropriate to each area and surface being protected.
 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 3. Erect temporary barriers to form and maintain fire-egress routes.
 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building when building will remain occupied during construction.
- B. Temporary Protection of Materials to Remain:
1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

3.2 PROTECTION FROM FIRE

- A. General: Follow the following:
1. Comply with NFPA 241 requirements unless otherwise indicated.
 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
1. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 2. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.

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3. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 4. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs. Comply with requirements in Section 01 32 33 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority (if applicable), or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
 - 1. Section 01 21 00 "Allowances" for testing and inspection allowances.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

SECTION 01 40 00
QUALITY REQUIREMENTS

- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services. Costs incurred for delegated-design services shall be paid for by the Contractor.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Mockup Shop Drawings: For stand-alone mockups.
 - 1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
 - 2. Indicate manufacturer and model number of individual components.
 - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Reports: Prepare and submit certified written reports and documents as specified.
- D. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee

SECTION 01 40 00
QUALITY REQUIREMENTS

payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

SECTION 01 40 00
QUALITY REQUIREMENTS

- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Stand-Alone Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 - 6. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 - 7. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 9. Demolish and remove mockups when directed unless otherwise indicated.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor. Costs for retesting and reinspecting construction that is in compliance with the Contract Documents shall be paid for by the Owner.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

**SECTION 01 40 00
QUALITY REQUIREMENTS**

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
- E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 5. Retesting and reinspecting corrected Work.

**SECTION 01 40 00
QUALITY REQUIREMENTS**

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
 - 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 42 00
REFERENCES

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.

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REFERENCES**

5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASSP - American Society of Safety Professionals (The); www.assp.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AVIXA - Audiovisual and Integrated Experience Association; (Formerly: Infocomm International); www.soundandcommunications.com.
38. AWEA - American Wind Energy Association; www.awea.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWWA - American Water Works Association; www.awwa.org.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
50. CDA - Copper Development Association; www.copper.org.
51. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>.
52. CEA - Canadian Electricity Association; www.electricity.ca.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.

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REFERENCES**

55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.compositepanel.org.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csa-group.org.
65. CSI - Construction Specifications Institute (The); www.csiresources.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTA - Consumer Technology Association; www.cta.tech.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.coolingtechnology.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHA - Decorative Hardwoods Association; (Formerly: Hardwood Plywood & Veneer Association); www.decorativehardwoods.org.
72. DHI - Door and Hardware Institute; www.dhi.org.
73. ECA - Electronic Components Association; (See ECIA).
74. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
75. ECIA - Electronic Components Industry Association; www.eciaonline.org.
76. EIA - Electronic Industries Alliance; (See TIA).
77. EIMA - EIFS Industry Members Association; www.eima.com.
78. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
79. EOS/ESD Association; (Electrostatic Discharge Association); www.esda.org.
80. ESTA - Entertainment Services and Technology Association; (See PLASA).
81. ETL - Intertek (See Intertek); www.intertek.com.
82. EVO - Efficiency Valuation Organization; www.evo-world.org.
83. FCI - Fluid Controls Institute; www.fluidcontrolsintitute.org.
84. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
85. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
86. FM Approvals - FM Approvals LLC; www.fmglobal.com.
87. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
88. FRSA - Florida Roofing, Sheet Metal Contractors Association, Inc.; www.floridarroof.com.
89. FSA - Fluid Sealing Association; www.fluidsealing.com.
90. FSC - Forest Stewardship Council U.S.; www.fscus.org.
91. GA - Gypsum Association; www.gypsum.org.
92. GANA - Glass Association of North America; (See NGA).
93. GS - Green Seal; www.greenseal.org.
94. HI - Hydraulic Institute; www.pumps.org.
95. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
96. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
97. HPVA - Hardwood Plywood & Veneer Association; (See DHA).
98. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
99. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
100. IAS - International Accreditation Service; www.iasonline.org.
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.

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REFERENCES**

107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
113. II - Infocomm International; (See AVIXA).
114. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
115. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
116. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
117. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
118. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
119. ISO - International Organization for Standardization; www.iso.org.
120. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
121. ITU - International Telecommunication Union; www.itu.int/home.
122. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
123. LMA - Laminating Materials Association; (See CPA).
124. LPI - Lightning Protection Institute; www.lightning.org.
125. MBMA - Metal Building Manufacturers Association; www.mbma.com.
126. MCA - Metal Construction Association; www.metalconstruction.org.
127. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
128. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
129. MHIA - Material Handling Industry of America; www.mhia.org.
130. MIA - Marble Institute of America; (See NSI).
131. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
132. MPI - Master Painters Institute; www.paintinfo.com.
133. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
134. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
135. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
136. NADCA - National Air Duct Cleaners Association; www.nadca.com.
137. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
138. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
139. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
140. NBI - New Buildings Institute; www.newbuildings.org.
141. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
142. NCMA - National Concrete Masonry Association; www.ncma.org.
143. NEBB - National Environmental Balancing Bureau; www.nebb.org.
144. NECA - National Electrical Contractors Association; www.necanet.org.
145. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
146. NEMA - National Electrical Manufacturers Association; www.nema.org.
147. NETA - InterNational Electrical Testing Association; www.netaworld.org.
148. NFHS - National Federation of State High School Associations; www.nfhs.org.
149. NFPA - National Fire Protection Association; www.nfpa.org.
150. NFPA - NFPA International; (See NFPA).
151. NFRC - National Fenestration Rating Council; www.nfrc.org.
152. NGA - National Glass Association (The); (Formerly: Glass Association of North America); www.glass.org.
153. NHLA - National Hardwood Lumber Association; www.nhla.com.
154. NLGA - National Lumber Grades Authority; www.nlga.org.

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REFERENCES**

155. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
156. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
157. NRCA - National Roofing Contractors Association; www.nrca.net.
158. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
159. NSF - NSF International; www.nsf.org.
160. NSI - National Stone Institute; (Formerly: Marble Institute of America); www.naturalstoneinstitute.org.
161. NSPE - National Society of Professional Engineers; www.nspe.org.
162. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
163. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
164. NWCB – Northwest Wall and Ceiling Bureau; www.nwcb.org.
165. NWFA - National Wood Flooring Association; www.nwfa.org.
166. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
167. PDI - Plumbing & Drainage Institute; www.pdionline.org.
168. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
169. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
170. RFCI - Resilient Floor Covering Institute; www.rfci.com.
171. RIS - Redwood Inspection Service; www.redwoodinspection.com.
172. SAE - SAE International; www.sae.org.
173. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
174. SDI - Steel Deck Institute; www.sdi.org.
175. SDI - Steel Door Institute; www.steeldoor.org.
176. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
177. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
178. SIA - Security Industry Association; www.siaonline.org.
179. SJI - Steel Joist Institute; www.steeljoist.org.
180. SMA - Screen Manufacturers Association; www.smainfo.org.
181. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
182. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
183. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
184. SPIB - Southern Pine Inspection Bureau; www.spib.org.
185. SPRI - Single Ply Roofing Industry; www.spri.org.
186. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
187. SSINA - Specialty Steel Industry of North America; www.ssina.com.
188. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
189. STI - Steel Tank Institute; www.steeltank.com.
190. SWI - Steel Window Institute; www.steelwindows.com.
191. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
192. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
193. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
194. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
195. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
196. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
197. TMS - The Masonry Society; www.masonrysociety.org.
198. TPI - Truss Plate Institute; www.tpinst.org.
199. TPI - Turfgrass Producers International; www.turfgrassod.org.
200. TRI - Tile Roofing Institute; www.tilerroofing.org.
201. UL - Underwriters Laboratories Inc.; www.ul.com.
202. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
203. USAV - USA Volleyball; www.usavolleyball.org.

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204. USGBC - U.S. Green Building Council; www.usgbc.org.
 205. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
 206. WA - Wallcoverings Association; www.wallcoverings.org.
 207. WASTEC - Waste Equipment Technology Association; www.wastec.org.
 208. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
 209. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
 210. WDMA - Window & Door Manufacturers Association; www.wdma.com.
 211. WI - Woodwork Institute; www.wicnet.org.
 212. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 2. ICC - International Code Council; www.iccsafe.org.
 3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; www.usace.army.mil.
 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 5. DOE - Department of Energy; www.energy.gov.
 6. EPA - Environmental Protection Agency; www.epa.gov.
 7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.govinfo.gov.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.

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- c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
 - 6. MILSPEC - Military Specification and Standards; (See DOD).
 - 7. USAB - United States Access Board; www.access-board.gov.
 - 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
- 1. OAR – Oregon Administrative Rules.
 - 2. ODOT – Oregon Department of Transportation; <https://www.oregon.gov/odot>.
 - 3. ODHS – Oregon Department of Human Services; <https://www.oregon.gov/dhs>.
 - 4. OHA – Oregon Health Authority; <https://www.oregon.gov/oha>.
 - 5. ORBCD – State of Oregon Building Codes Division; <https://www.oregon.gov/bcd>.
 - 6. ORS – Oregon Revised Statutes.
 - 7. OSSC – Oregon Structural Specialty Code (Oregon amendments to the International Building Code (IBC)).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, Architect's consultants, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress (if applicable for existing facilities): Comply with applicable provisions in ICC/ANSI A117.1.

1.4 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.
- B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.
- D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

2.2 TEMPORARY FACILITIES

- A. Field Offices: Owner will provide conditioned interior space for field offices for duration of Project.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction. Additionally, cover supply register boots in floors with a filtration material preventing dirt, dust or construction debris from entering the dust system and remove at end of construction.
 - a. Contractor shall assume full responsibility for entire air circulation system.
 - b. Contractor shall pay costs for operation, maintenance and restoration of system.
 - c. Inspect filters regularly and replace dirty filters immediately.
 - d. Guarantee and Warranty Period of permanent heating and ventilating system shall commence upon Owner's acceptance of system as specified in Section 01 77 00.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install Wi-Fi cell phone access equipment and one land-based telephone line for each field office.
- J. Electronic Communication Service: Provide secure Wi-Fi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Utilize designated area within existing building for temporary field offices.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary offsite parking areas for construction personnel.
- D. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs, so they are legible at all times.
- G. Waste Disposal Facilities: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- J. Existing Stair Usage: If applicable, use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

- F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- J. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and/or tenants from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 - 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 3. Insulate partitions to control noise transmission to occupied areas.
 - 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 5. Protect air-handling equipment.
 - 6. Provide walk-off mats at each entrance through temporary partition.
- K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 NOISE AND VIBRATION CONTROL

- A. Work Carried Out Adjacent to Occupied Spaces: It is essential that the Work be performed in a manner to produce the least interference and inconvenience to building occupants. Use methods and equipment that will keep noise and vibration to a minimum.
- B. Provide and maintain adequate and effective mufflers, sound barriers and controls for all construction equipment so that noise from such equipment can be controlled to satisfaction of Owner's Representative.
- C. Coordinate with Owner's Representative when construction activities require use of air hammers, structural steel erection and other objectionable sources of noise.
- D. Cooperate with Owner's Representative by informing in advance of particularly noisy operations or operations causing excessive vibrations, so that owner's Representative may warn building occupants.
- E. Owner may, at his/her discretion and expense, monitor noise and vibration levels around construction site and adjacent buildings and spaces.

3.7 MOISTURE AND MOLD CONTROL

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

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.8 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 01 21 00 "Allowances" for products selected under an allowance.
 - 3. Section 01 23 00 "Alternates" for products selected under an alternate.
 - 4. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
 - 5. Section 01 42 00 "References" for applicable industry standards for products specified.
 - 6. Section 01 77 00 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

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1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."
- F. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Resolution of Compatibility Disputes between Multiple Contractors:
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

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

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:

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PRODUCT REQUIREMENTS**

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. **Manufacturer's Warranty:** Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 2. **Special Warranty:** Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. **Special Warranties:** Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. **Manufacturer's Standard Form:** Modified to include Project-specific information and properly executed.
 2. **Specified Form:** When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. **Submittal Time:** Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. **General Product Requirements:** Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. **Standard Products:** If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. **Or Equal:** For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

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PRODUCT REQUIREMENTS**

- a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
- 1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 - 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
 - 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
 - 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
 - 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
 - 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
 - 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 33 00 "Submittal Procedures."
 1. Form of Approval of Submittal: As specified in Section 01 33 00 "Submittal Procedures."
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 73 00
EXECUTION**

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner's portion of the Work.
 - 6. Coordination of Owner-installed products.
 - 7. Progress cleaning.
 - 8. Starting and adjusting.
 - 9. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for coordination of Owner-furnished products, Owner-performed work, Owner's separate contracts, and limits on use of Project site.
 - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
 - 3. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 4. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

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

1.3 INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 01 40 00 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.

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- c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
- a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems (if applicable), and other construction affecting the Work.

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1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and/or Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor or professional engineer experienced in laying out the Work, using the following accepted surveying practices:
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 2. Establish limits on use of Project site.
 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 4. Inform installers of lines and levels to which they must comply.
 5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

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- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.

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3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 1. Comply with Section 01 77 00 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 01 10 00 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

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- a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
- b. Restore damaged pipe covering to its original condition.
- 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
- 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
- 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
 - 1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
 - 2. Refer to Section 01 10 00 "Summary" for other requirements for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

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- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and/or construction waste.
 - 2. Recycling nonhazardous demolition and/or construction waste.
 - 3. Disposing of nonhazardous demolition and/or construction waste.
- B. Sustainability Requirements:
 - 1. The Owner has established that this project shall generate the least amount of waste possible. Of the inevitable waste that is generated, materials shall be reused, salvaged or recycled such that the waste disposal in landfills shall be minimized. The Contractor shall employ processes that ensure compliance with this requirement.
 - a. The project goal is to divert 95% of wood and cardboard from landfill.
 - b. The project goal is to divert 95% of gypsum board from landfill. (if a gypsum recycling facility is available within 50 miles of the project site)
 - c. The Contractor shall provide documentation of waste diversion to the Owner upon completion of the project.

1.2 CLOSEOUT SUBMITTALS

- A. Submit documentation of waste diversion.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management including responsibilities of each contractor.
 - 2. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 4. Review waste management requirements for each trade.

**SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Contractor shall coordinate with local haulers to sort on site and salvage/recycle project demolition and construction waste materials from site including, but not limited to, the following:
 - 1. Wood: Clean dimensional lumber, pallet wood, composite wood panels (such as plywood, OSB, particle board, MDF), etc.
 - 2. Masonry, concrete and stone rubble.
 - 3. Metals from banding, stud trim, ductwork, piping, reinforcing steel, metal roofing and trim. Includes steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass and bronze.
 - 4. Gypsum board, unpainted,
 - 5. Corrugated cardboard, paper products and packaging.
 - 6. Acoustical ceiling tile.
 - 7. Light fixtures and electrical equipment.
 - 8. Plumbing fixtures.
 - 9. Glass, including window glass and beverage containers.
 - 10. Carpet and Pad: Offcuts and remainder greater than 1 sq. ft. Set aside for reuse or donation.
 - 11. Plastic, including beverage containers.
 - 12. Rigid foam.
 - 13. Perlite Products: If possible, return to manufacturer for recycling.
 - 14. Paints and coatings: If requested, set aside extra paint for future color matches or reuse by Owner. Where possible, collect all waste paint and coating products, separate by product type, and provide for delivery to recycling or collection facility.
 - 15. Field office waste, including paper, aluminum cans, glass, plastic and cardboard.

PART 3 - EXECUTION

3.1 IMPLEMENTATION

- A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 02 41 19 "Selective Demolition" for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.

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CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for Sale and Donation: Not permitted on Project site.
- D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- I. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- K. Carpet Tile: Remove debris, trash, and adhesive.

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CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- L. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- M. Conduit: Reduce conduit to straight lengths and store by material and size.
- N. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
- D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.

END OF SECTION

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 01 32 33 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 4. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Section 01 79 00 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number.
 5. Submit testing, adjusting, and balancing records.
 6. If applicable, submit sustainable design submittals not previously submitted.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 01 29 00 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Include warranties in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - h. Vacuum and mop concrete.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment (if applicable), and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - q. Clean strainers.
 - r. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION

**SECTION 01 78 23
OPERATION AND MAINTENANCE DATA**

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit in PDF electronic format. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

1.5 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager, if applicable.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority, if applicable.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.7 **SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS**

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.

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4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 1. Do not use original project record documents as part of maintenance manuals.

1.8 **PRODUCT MAINTENANCE MANUALS**

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

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OPERATION AND MAINTENANCE DATA

- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 78 39
PROJECT RECORD DOCUMENTS**

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
- B. Related Requirements:
 - 1. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 - 2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned Record Prints and one set of file prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.

**SECTION 01 78 39
PROJECT RECORD DOCUMENTS**

- l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record prints with erasable, red-colored pencil or pen. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. Note related Change Orders and Record Drawings where applicable.
- B. Format: Submit record specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.5 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 79 00
DEMONSTRATION AND TRAINING**

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1.3 QUALITY ASSURANCE

- A. Instructor Qualifications: A representative, experienced in operation and maintenance procedures and training.

1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.5 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:

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DEMONSTRATION AND TRAINING**

- a. Instructions on meaning of warnings, trouble indications, and error messages.
- b. Instructions on stopping.
- c. Shutdown instructions for each type of emergency.
- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.
- f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.6 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.7 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

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DEMONSTRATION AND TRAINING**

1. Schedule training with Owner with at least seven days' advance notice. Notify Architect of training dates, times and locations.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION

**SECTION 02 41 19
SELECTIVE DEMOLITION**

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 01 35 16 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
 - 3. Section 01 73 00 "Execution" for cutting and patching procedures.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.5 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

**SECTION 02 41 19
SELECTIVE DEMOLITION**

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. When demolition work has been performed by Owner, verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents, when available, of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
 - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

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

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

SECTION 02 41 19
SELECTIVE DEMOLITION

- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least two (2) hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

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SELECTIVE DEMOLITION

10. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Division 7 for new roofing requirements.
 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**SECTION 02 41 19
SELECTIVE DEMOLITION**

END OF SECTION

**SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES**

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Waterstops.
 - 3. Shoring, bracing, and anchoring.
- B. Related Requirements:
 - 1. Section 32 13 13 "Concrete Paving" for formwork related to concrete pavement and walks.

1.2 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Waterstops.
- B. Shop Drawings: Detailing fabrication, assembly, and support of forms.
 - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
 - a. Location of construction joints is subject to approval of the Architect.
 - 3. Indicate location of waterstops.
 - 4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

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1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to no more than 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 1. Provide continuous, true, and smooth concrete surfaces.
 2. Furnish in largest practicable sizes to minimize number of joints.
 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).
 - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
 - 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
 - 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces not exceeding specified formwork surface class.
 1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

2.3 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

2.4 RELATED MATERIALS

- A. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- B. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
- C. Keyed Construction/Isolation Joints: Dayton Superior – G33 Screed Key Joint, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- K. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls as indicated on Drawings.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 12 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

END OF SECTION

**SECTION 03 20 00
CONCRETE REINFORCING**

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel reinforcement bars.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of the Architect.
- D. Welding Certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. and to avoid damaging coatings on steel reinforcement.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: As indicated on the Drawings.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

**SECTION 03 20 00
CONCRETE REINFORCING**

- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater, unless otherwise noted.
 - 2. Stagger splices in accordance with ACI 318.
 - 3. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

3.3 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel-reinforcement placement.

END OF SECTION

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 03 10 00 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
 - 2. Section 03 20 00 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Slag cement.
 - 4. Blended hydraulic cement.
 - 5. Silica fume.
 - 6. Performance-based hydraulic cement
 - 7. Aggregates.
 - 8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
 - 9. Color pigments.
 - 10. Fiber reinforcement.
 - 11. Vapor retarders.
 - 12. Floor and slab treatments.
 - 13. Liquid floor treatments.
 - 14. Curing materials.
 - 15. Joint fillers.
 - 16. Repair materials.
- B. Design Mixtures: For each concrete mixture, no later than 15 days prior to the start of Work or mockups, include the following:
 - 1. Mixture identification, including location of the Work where employed.
 - 2. Minimum 28-day compressive strength.
 - 3. Durability exposure class.
 - 4. Maximum w/cm.
 - 5. Slump limit.
 - 6. Air content.
 - 7. Nominal maximum aggregate size.
 - 8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 - 9. Intended placement method.

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

- 10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - C. Shop Drawings:
 - 1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
 - D. Samples: For manufacturer's standard colors for color pigment.
 - E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
 - 1. Concrete Class designation.
 - 2. Location within Project.
 - 3. Exposure Class designation.
 - 4. Formed Surface Finish designation and final finish.
 - 5. Final finish for floors.
 - 6. Curing process.
 - 7. Floor treatment if any.
 - F. Placement Schedule: Submit before start of placement operations.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Floor surface flatness and levelness measurements report indicating compliance with specified tolerances.
 - B. Preconstruction Test Reports: For each mix design.
 - C. Field quality-control reports.
 - D. Minutes of preinstallation conference.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: A firm specializing in work of this Section and able to demonstrate a minimum of 5 years documented experience in successful quality work of comparable scope and quality when requested by the Architect.
- 1.6 PRECONSTRUCTION TESTING
- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Comply with ASTM C94/C94M and ACI 301.
- 1.8 FIELD CONDITIONS
- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

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- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.
- B. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 - 3. Obtain aggregate from single source.
 - 4. Obtain each type of admixture from single source from single manufacturer.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
 - 2. Fly Ash: ASTM C618, Class C or F.
 - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 - 4. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal for footings where concrete reinforcing spacing allows. Aggregate size shall not be greater than fifty percent of the smallest spacing between reinforcing bars. Reduce size to 3/4 inch for all other work.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - 3. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on sieves finer than No. 50.
- C. Air-Entraining Admixture: ASTM C260/C260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- E. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4.

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Fortifiber Building Systems Group.](#)
 - b. [Stego Industries, LLC.](#)
 - c. [W.R. Meadows, Inc.](#)

2.4 LIQUID FLOOR TREATMENTS

- A. See Section 03 35 43 "Polished Concrete Finishing" for Liquid Floor Treatments.

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2.5 CURING MATERIALS

- A. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Creteseal.
 - b. Dayton Superior.
 - c. W.R. Meadows, Inc.
 - d. Masco.
 - 2. For integrally colored concrete, curing materials shall be approved by color pigment manufacturer.
 - 3. For concrete indicated to be sealed, curing materials shall be compatible with sealer.
- B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete intended for application immediately after concrete placement.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Dayton Superior.
 - c. W.R. Meadows, Inc.
 - d. The Euclid Chemical Company.
- C. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- D. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.
- E. Curing Paper: Eight-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Fortifiber Building Systems Group.
- F. Water: Potable or complying with ASTM C1602/C1602M.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
 - 1. Curved Applications: ASTM D4819, Type II.
 - a. Product: WR Meadows Deck-o-Foam or equal.
 - b. Thickness: 1/4-inch unless otherwise indicated or as required for application.
- B. Semirigid Joint Filler, Normal-Duty: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 55 in accordance with ASTM D2240.
- C. Semirigid Joint Filler, Heavy-Duty: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- D. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- E. Floor Slab Protective Covering: Eight-feet-wide cellulose fabric.

2.7 REPAIR MATERIALS

- A. Repair, General:
 - 1. For exposed applications, provide products and design mix using ASTM C979 colored pigments and colored aggregates proportioned as required to match existing color and texture of existing concrete slabs.
 - 2. Products: Provide products complying with requirements by one of the following:
 - a. Ardex.
 - b. Laticrete.
 - c. Sika.
 - d. Mapei.

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- B. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested in accordance with ASTM C109/C109M.
- C. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 20 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: Except where otherwise indicated for concrete to receive a polished concrete finish, 50 percent by mass, with fly ash or pozzolans not exceeding 20 percent by mass and silica fume not exceeding 10 percent by mass.
 - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: Except where otherwise indicated for concrete to receive a polished concrete finish, 30 percent by mass with fly ash or pozzolans not exceeding 20 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

2.9 CONCRETE MIXTURES

- A. Normal-Weight Concrete:
 - 1. Minimum Compressive Strength: As indicated on the Structural Drawings.
 - 2. Maximum w/cm: As indicated on the Structural Drawings, except as otherwise indicated.
 - 3. Air Content: At exterior horizontal surfaces permanently exposed to weather or where concrete flatwork may be subjected to freezing temperatures in a temporary condition: 4.5 percent, plus or minus 1.0 percent at point of delivery.
 - a. Air-entraining admixture shall not be used in concrete mixes for flatwork that is to receive a hard-troweled or polished concrete finish.

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2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.
- B. All plumbing piping, HVAC and sewerage piping penetrations shall have expansion joint material at interface with concrete. No piping shall be embedded without expansion material unless otherwise permitted by code any by Work of Divisions 21 through 28.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

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- B. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints in Slabs-on-Grade: Saw weakened plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades as indicated below. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
 - a. Equipment Control Joint Saw: "Soff-Cut System," early-entry dry-cut saw with Skid Plate, by Soff-Cut. 1112 Olympic Drive, Corona, CA 92881 909-272-2330.
 - b. Comply with the Soff-Cut instructions for the SOFF-CUT System, except as noted below.
 - c. Troweled Finish: Install cuts at each joint location no earlier than 4 hours and no later than 12 hours after concrete placement.
 - d. Remove debris in path of cut and under Skid Plate before cutting. Skid Plate must remain flat on surface.
 - e. Use Soff-Cut blades and Skid Plates, using a new Skid Plate with each new blade.
 - f. Install Soff-Cut joint protector at saw-cut intersection prior to cross-cut.
 - g. Remove dry powder without disturbing finish.
 - h. Avoid traffic across saw cut until sufficient strength is gained to protect joint edges.
 2. Provide control joints in compliance with spacing requirements of ACI 360R, unless otherwise indicated on the Drawings.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 48 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Scream slab surfaces with a straightedge and strike off to correct elevations.

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5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view.
3. ACI 301 Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.

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6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Grade:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 1. Coordinate required final finish with Architect before application.
 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with Architect before application.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
 1. Begin curing immediately after finishing concrete.
 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

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- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.

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- 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
 - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
 - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing and Sealing Compound:
 - 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

- A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than 28 days' old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 - 4. Rinse with water; remove excess material until surface is dry.
 - 5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.
 - 1. Apply to all exposed concrete floor slab surfaces not scheduled to receive other floor finishes. Refer to Drawings for schedule of floor finishes.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month.
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
 - 1. Use Normal-Duty joint filler for typical locations subject to normal traffic.
 - 2. Use Heavy-Duty joint filler for locations subject to repeated forklift traffic or other heavy equipment.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

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- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 3. After concrete has cured at least 14 days, correct high areas by grinding.
 - 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 - 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 - 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 - 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

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- a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Inspections: As indicated on the Drawings and as follows:
- 1. Headed bolts and studs.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.
 - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 - 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- D. Concrete Tests: As indicated on the Drawings and as follows:

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1. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
2. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
3. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
4. Additional Tests:
 - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.
5. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
6. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.16 PROTECTION

- A. Protect concrete surfaces as follows:
 1. Protect from petroleum stains.
 2. Diaper hydraulic equipment used over concrete surfaces.
 3. Prohibit vehicles from interior concrete slabs.
 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 5. Prohibit placement of steel items on concrete surfaces.
 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION

SECTION 03 35 43
POLISHED CONCRETE FINISHING

SECTION 03 35 43 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Polished concrete finishing.
 - 2. Concrete for polished concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete not designated as polished concrete.

1.2 DEFINITIONS

- A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.
- B. CPC: Concrete Polishing Council, a Specialty Council of the American Society of Concrete Contractors.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site prior to placing concrete for mockups and for areas scheduled for final polishing work. Comply with requirements of Section 03 30 00 "Cast-in-Place Concrete" and review the following additional items:
 - 1. Mockup requirements.
 - 2. Approved submittals.
 - 3. Environmental requirements.
 - 4. Scheduling and phasing of work.
 - 5. Coordinating with other work and personnel.
 - 6. Protection of adjacent surfaces.
 - 7. Surface preparation.
 - 8. Dust control.
 - 9. Repair of defects and defective work prior to installation.
 - 10. Cleaning.
 - 11. Installation of polished floor finishes, including procedural steps of grinding, honing and polishing operations.
 - 12. Application of liquid hardener, densifier.
 - 13. Protection of floor surfaces prior to polishing or application of dye.
 - 14. Protection of finished surfaces after installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Installer.
 - a. Include data evidencing requirements indicated.
 - b. Submit a minimum of 5 projects of similar size and scope to this Project. List materials used for each, finish levels. Include name of General Contractor, Owner and Architect for each project.
 - 2. For field testing.

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- B. Minutes of preinstallation conference.
- C. Concrete Floor Protection Plan: Submit methods, products and jobsite implementation plan to provide post-placement and post-polishing protection of slabs to receive polished concrete finishing.
- D. Dynamic Coefficient of Friction (DCOF) field test reports.
- E. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
 - 1. Include manufacturer's instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
 - 2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

1.6 **QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced specialist, as defined by Section 01 40 00 "Quality Requirements."
 - 1. Experience: Entity experienced in performing specified work similar in design, products, and extent of scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce specified work.
 - a. Supervision: Maintain competent supervisor who is at Project during times specified work is in progress and has experience completing projects similar to that of the final Work.
 - b. Supervisor shall be approved and trained by material manufacturers for placement of materials and use of equipment required for polishing Work.
- B. **Mockup at existing slab:** Before polishing entire area of concrete scheduled to receive a polished finish, provide in-place mockup to demonstrate the approved range of selections made under Sample submittals and to demonstrate the expected range of finish and appearance variations.
 - 1. Slab on Grade:
 - a. Minimum of 30-square-foot mockup area.
 - 2. Notify Architect and Owner seven (7) days in advance of dates and times when mockups will be constructed.
 - 3. Approval of mockup(s) will be by the Architect and Owner based on the aesthetic qualities and on the following:
 - a. Compliance with approved submittals.
 - b. Compliance with specified Appearance Level.
 - c. Compliance with specified Aggregate Exposure Class.
 - d. Compliance with specified dynamic coefficient of friction.
 - 4. When directed, demonstrate repair techniques on the mockup(s). Only approved techniques shall be used in the final Work.
 - 5. Obtain Architect's and Owner's approval before starting the final Work. Approval of mockups does not constitute approval of deviations from Contract Documents unless Architect specifically approves deviations in writing.
 - 6. Protect and maintain approved field mockup(s) during construction in an undisturbed condition as a standard for judging the completed final Work.
 - 7. Mockup may remain as part of the final Work only if explicit directions to do so are given by the Owner and Architect.
- C. **Mockup at new slab:** Before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals and to demonstrate the expected range of finish, color, and appearance variations.
 - 1. Slab on Grade:
 - a. Form, reinforce, and cast a minimum 30-square-foot sample panel.
 - b. Incorporate the same subgrade preparation, sub-base material, vapor retarder, reinforcing, slab thickness, and concrete mix design as that of the final Work.
 - c. Incorporate sample of joint pattern and hand tool finishing as directed.
 - 2. Final number, sizes and locations of mockups shall be approved in advance by the Architect and Owner.
 - 3. Provide separate mockups for each specified Appearance Level, each specified Aggregate Exposure Class, and each dyed color.

SECTION 03 35 43
POLISHED CONCRETE FINISHING

4. Notify Architect and Owner seven (7) days in advance of dates and times when mockups will be constructed.
5. Placement, curing, finishing and protection work shall match that of final Work and shall be performed by the same personnel as will place and finish the final Work.
 - a. Mockups shall demonstrate dust control measures.
6. Approval of mockup(s) will be by the Architect and Owner based on the aesthetic qualities and on the following:
 - a. Compliance with approved submittals.
 - b. Compliance with specified Appearance Level.
 - c. Compliance with specified Aggregate Exposure Class.
 - d. Compliance with specified dynamic coefficient of friction.
7. When directed, demonstrate repair techniques on the mockup(s). Only approved techniques shall be used in the final Work.
8. Obtain Architect's and Owner's approval before starting the final Work. Approval of mockups does not constitute approval of deviations from Contract Documents unless Architect specifically approves deviations in writing.
9. Protect and maintain approved field mockup(s) during construction in an undisturbed condition as a standard for judging the completed final Work.
10. Mockup may remain as part of the final Work only if explicit directions to do so are given by the Owner and Architect.
 - a. Demolish and remove field sample panels when directed.

1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX Americas.
 - b. Laticrete International, Inc.
 - c. Lythic by Solomon Colors.
 - d. MAPEI Corporation.
 - e. PROSOCO, Inc.
- B. Film-Forming Liquid Floor Sealer: Clear, epoxy concrete floor sealer for concrete surfaces.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Tnemec Company, Inc.
 2. Epoxy finish system as follows:
 - a. Primer/Base Coat: Series 233 Power-Tread LE. Apply at 5.0-7.0 mils DFT.
 - b. Top Coat: Series 248 Everthane. Apply at 2.0-3.0 mils DFT.

PART 3 - EXECUTION

3.1 POLISHING

- A. Performance Description:
 1. Appearance Level: As defined by CPC and as follows:
 - a. Level 2: Satin (Honed) 400 Grit Max.
 - b. Image Clarity Value, %: ASTM D5767; achieve an average distinction of image (DOI) value between 10-39, measured prior to application of sealers.

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2. Aggregate Exposure: As defined by CPC and as follows:
 - a. Class A, Cream.
- B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 3. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
 4. Control and dispose of waste products produced by grinding and polishing operations.
 5. Neutralize and clean polished floor surfaces.

3.2 SEALING

- A. Thoroughly clean floors and remove debris. Remove residues using non-corrosive cleaning products.
- B. Concrete Densifier:
 1. Apply a field test of surface densifier at a location chosen by Architect.
 2. Review results with Architect to verify if application to entire floor is recommended. Proceed as directed.
 - a. Apply treatment in single application.
 - b. Distribute using exploded-tip bristle broom to uniform coverage.
 - c. Allow to air dry.
 - d. At ambient temperatures above 65 degrees F, keep surfaces hydrated for one hour after application.
 - e. After drying, remove un-reacted material using broom.
- C. Surface Sealer:
 1. Apply two coats of sealer per manufacturer's printed directions.
 2. Use T-bar applicator and micro-head.
 3. Allow minimum one hour drying time between applications.
 4. Application to be performed by a certified applicator, certified by the product manufacturer.

3.3 TESTING

- A. Test slip resistance of finished concrete floor. Slip resistance shall meet ASTM C 1028 or CTI method; permanent wet leather and wet pavement; 0.6 for level surfaces; 0.8 for sloped surfaces.

3.4 CLEANING

- A. Keep premises clean and free of debris at all times.
- B. Remove spatter from adjoining surfaces, as necessary.
- C. Repair damages to surface caused by cleaning operations.
- D. Remove debris from jobsite. Dispose of materials in separate, closed containers in accordance with local regulations.

3.5 PROTECTION

- A. After completion of polishing, protect polished floors from subsequent construction activities. Cover with breathable product such as kraft paper or thin curing blanket. Do not cover with Masonite, plywood or polyethylene sheets.
 1. Do not tape protection to finished floor surfaces.
- B. Provide signage near floor surfaces to receive a Polished Concrete finish indicating that adjacent floors will remain exposed in final condition and identifying any work limitations associated with the Concrete Floor Protection Plan.

END OF SECTION

SECTION 05 40 00
COLD-FORMED METAL FRAMING

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior non-load-bearing Z-Girts.
 - 2. Blocking.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Exterior non-load-bearing z-girts.
 - 2. Blocking.
 - 3. Steel attachment clips.
 - 4. Thermal spacer breaks.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of code-compliance certification for Z-Girts and Blocking.
- C. Research Reports:
 - 1. For nonstandard cold-formed steel framing screw fasteners and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
 - 2. For thermal spacer break, showing properties that match material type, size, and thickness of thermal spacer breaks installed at existing premanufactured metal building.

1.4 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- B. Code-Compliance Certification of Z-Girts and blocking: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. [ClarkDietrich](#).
 - 2. [SCAFCO Steel Stud Company](#).
 - 3. [Steeler, Inc.](#)

2.2 PERFORMANCE REQUIREMENTS

- A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100 and AISI S200.

SECTION 05 40 00
COLD-FORMED METAL FRAMING

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G90 or equivalent.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Z-Girts: Manufacturer's standard Z-shaped steel girts, of profile matching existing premanufactured metal building, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Match existing premanufactured metal building z girt thickness.
 - 2. Flange Width: Match existing premanufactured metal building z girt thickness.
 - 3. Section Properties: Match existing premanufactured metal building z girt thickness.

2.5 ANCHORS, CLIPS, BLOCKING, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Match existing premanufactured building fastener type.
- C. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS {Not reviewed by WDY}

- A. Galvanizing Repair Paint: ASTM A780/A780M.
- B. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- C. Thermal Spacer Breaks: Match existing premanufactured metal building thermal spacers breaks.

2.7 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members or clips by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted. Match existing building z girt attachment method.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to the Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

**SECTION 05 40 00
COLD-FORMED METAL FRAMING**

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Install thermal spacer breaks between z girts and adjacent materials to match installation method at existing manufactured metal building.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install framing members in one-piece lengths unless splice connections are indicated.
- E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- G. Reinstall existing insulation and vapor barrier to match existing adjacent installation.

3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

- A. Install z girts sized to match existing z girts. Slope lowest z girt row parallel with new manufactured metal building roof slope.
- B. Install miscellaneous framing and connections, including clip angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 REPAIR {Not reviewed by WDY}

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

SECTION 05 40 00
COLD-FORMED METAL FRAMING

3.8 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

**SECTION 05 50 00
METAL FABRICATIONS**

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for overhead doors.
 - 2. Metal ladders.
 - 3. Personal protection equipment drying rack.
 - 4. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Related Requirements:
 - 1. Section 13 34 19 "Metal Building Systems" for steel framing and metal fabrications supplied by metal building contractor.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Fasteners.
 - 2. Shop primers.
 - 3. Shrinkage-resisting grout.
 - 4. Manufactured metal ladders.
- B. Shop Drawings: Provide Shop Drawings for all items.
 - 1. Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections.
 - 2. Show anchorage and accessory items.
 - 3. Show weep holes.
 - 4. Show vent holes.
- C. Delegated-Design Submittal: For items indicated, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research Reports: For post-installed anchors.

**SECTION 05 50 00
METAL FABRICATIONS**

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders.
- B. Structural Performance of Ladders: Ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum, stainless steel or nickel silver.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

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2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that are compatible with intermediate and topcoats specified in Section 09 91 23 "Interior Painting."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- F. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Provide vent holes in assemblies scheduled for hot-dip galvanizing. Locate vent holes in surfaces indicated and in a manner to exclude and not capture water.
- I. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- J. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- K. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

SECTION 05 50 00
METAL FABRICATIONS

- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3 and OSHA 1926.1053.
- B. Steel Ladders:
 - 1. Space siderails 18 inches apart unless otherwise indicated.
 - 2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
 - 3. Rungs: 3/4-inch-diameter, steel bars. Rung spacing shall be no more than 14 inches o.c.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 - 6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
 - 7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
 - 8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
 - 9. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
 - 10. Prime interior ladders, including brackets and fasteners.

2.8 PERSONAL PROTECTIVE EQUIPMENT DRYING RACK

- A. Provide schedule 40 galvanized pipe, pipe connectors, wall and floor attachment flanges as required for the construction of the personal protective equipment drying rack. See Drawings for additional information.

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.
- C. Prime plates with zinc-rich primer.

2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel dowel bar anchors for embedding in concrete.

2.11 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - 2. Galvanize all items scheduled to be permanently exposed to the exterior.
 - 3. Galvanize all exterior items scheduled to be embedded in concrete or masonry.

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METAL FABRICATIONS**

4. Galvanize other items as indicated on the Drawings.
 5. Fill vent holes and repair galvanizing finish, for holes located and exposed to the exterior except those providing drainage.
- B. Preparation of Items for Shop Priming:
1. Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process. Prepare surfaces to comply with SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
 2. Non-Galvanized Items, Permanently Concealed From View: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
 3. Non-Galvanized Items, Permanently Exposed to View: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Shop prime iron and steel items as follows:
 - a. Interior Items, Permanently Concealed From View: Shop prime items. Apply two coats of shop primer.
 - b. Interior Items, Permanently Exposed View: Shop prime items. Apply one coat of shop primer followed with a sanding with minimum 120 grit abrasive. Apply second coat of shop primer.
 2. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 3. Do not shop prime items scheduled to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 4. Do not shop prime items to be field welded.
 5. Do not shop prime items to be high-strength bolted with slip-critical connections.
- D. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

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METAL FABRICATIONS**

- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 **INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS**

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.

3.3 **INSTALLATION OF BEARING AND LEVELING PLATES**

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 **REPAIRS**

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

**SECTION 06 10 00
ROUGH CARPENTRY**

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Framing with timber.
 - 3. Framing with engineered wood products.
 - 4. Wood blocking and nailers.
- B. Related Requirements:
 - 1. Section 06 16 00 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Engineered wood products.
 - 3. Power-driven fasteners.
 - 4. Post-installed anchors.
 - 5. Metal framing anchors.
- B. Sustainable Design Submittals:
 - 1. Test Reporting: Moisture content levels of framing lumber and sheathing.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- B. Testing Agency Qualifications: For testing agency providing moisture content levels, a third-party inspection agency capable of performing moisture content testing of framing lumber and sheathing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated on the Drawings.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, shall meet or exceed those indicated on the Structural Drawings. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.
 - 6. Wood framing to remain permanently exposed to weather.

2.3 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
 - 1. Application: Interior partitions not indicated as load bearing.
 - 2. Species:
 - a. Western woods; WCLIB or WWPA.
- B. Load-Bearing Partitions: No. 2 grade, unless otherwise indicated on the Drawings.
 - 1. Application: interior load-bearing partitions.
 - 2. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
- C. Ceiling Joists: Construction or No. 2 grade, otherwise indicated on the Drawings.

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1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
- D. Joists, Rafters, and Other Framing Not Listed Above: As indicated on the Drawings.
 1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
- E. Exposed Framing: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
 1. Species and Grade: As indicated above for load-bearing construction of same type.

2.4 TIMBER FRAMING

- A. Comply with the following requirements, according to grading rules of grading agency indicated:
 1. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; grade as indicated on the Drawings; NLGA, WCLIB, or WWPA.
 2. Maximum Moisture Content: As indicated on the Drawings.
 3. Additional Restriction: Free of heart centers.

2.5 ENGINEERED WOOD PRODUCTS

- A. Composite Wood Products: Verify products are made without added urea formaldehyde.
- B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- C. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boise Cascade Company.
 - b. Louisiana-Pacific Corporation.
 - c. Redbuilt.
 - d. Roseburg.
 - e. Weyerhaeuser Company.
 2. Extreme Fiber Stress in Bending, Edgewise: Psi as indicated on the Drawings for 12-inch nominal-depth members.
 3. Modulus of Elasticity, Edgewise: Psi as indicated on the Drawings.
- D. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Weyerhaeuser Company.
 2. Extreme Fiber Stress in Bending, Edgewise: Psi as indicated on the Drawings.
 3. Modulus of Elasticity, Edgewise: Psi as indicated on the Drawings.
- E. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Comply with material requirements of and with structural capacities established and monitored according to ASTM D5055.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boise Cascade Company.
 - b. Louisiana-Pacific Corporation.
 - c. Redbuilt.
 - d. Roseburg.
 - e. Weyerhaeuser Company.
 2. Structural Properties: Depths and design values not less than those indicated on the Drawings.

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ROUGH CARPENTRY**

- F. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research or evaluation report for I-joists.
 - 1. Manufacturer: Provide products by same manufacturer as I-joists.
 - 2. Material: All-veneer product, glued-laminated wood, or product made from any combination solid lumber, wood strands, and veneers.
 - 3. Thickness: As indicated on the Drawings.

2.6 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Cants.
 - 4. Furring.
 - 5. Grounds.
 - 6. Utility shelving.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:
 - 1. Western woods; WCLIB or WWPA.
- C. Concealed Boards: 15 percent maximum moisture content and of the following species and grades:
 - 1. Western woods; Construction or No. 2 Common or Standard or No. 3 Common grade; WCLIB or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.7 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: As indicated on the Drawings.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.

2.8 METAL FRAMING ANCHORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
 - 1. [Simpson Strong-Tie Co., Inc.](#)
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products indicated on the Drawings. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.

**SECTION 06 10 00
ROUGH CARPENTRY**

2.9 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install shear wall panels to comply with manufacturer's written instructions.
- E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- G. Do not splice structural members between supports unless otherwise indicated.
- H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- J. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- K. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- L. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.2, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. ICC-ES evaluation report for fastener.
- N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials.

**SECTION 06 10 00
ROUGH CARPENTRY**

Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

- O. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 - 1. Comply with indicated fastener patterns where applicable.
 - 2. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 INSTALLATION OF WALL AND PARTITION FRAMING

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs. Fasten plates to supporting construction unless otherwise indicated.
 - 1. For interior partitions and walls, provide 2-by-6-inch nominal or 2-by-4-inch nominal- size wood studs spaced 16 inches o.c. Stud size required for each partition type indicated on the Drawings.
 - 2. Except as otherwise indicated, provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. Except as otherwise indicated, for non-load-bearing partitions, provide single trimmer and single king studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
 - 2. Except as otherwise indicated, for load-bearing walls, provide double trimmer and single king studs for openings 60 inches and less in width, and double trimmer and double king studs for wider openings. Provide headers of depth indicated.

3.4 INSTALLATION OF FLOOR JOIST FRAMING

- A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
 - 1. Where supported on wood members, by toe nailing or by using metal framing anchors where indicated.
 - 2. Where framed into wood supporting members, by using wood ledgers or metal joist hangers as indicated.
- B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches unless otherwise indicated.
- C. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than 2 inches from top or bottom.
- D. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.
- E. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.
- F. Provide solid blocking between joists under jamb studs for openings.

**SECTION 06 10 00
ROUGH CARPENTRY**

- G. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
 - 1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

3.5 INSTALLATION OF CEILING JOIST FRAMING

- A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters unless otherwise indicated.

3.6 INSTALLATION OF TIMBER FRAMING

- A. Install timber beams with crown edge up and provide not less than 4 inches of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports as indicated if not continuous.
- B. Install wood posts using metal anchors indicated.
- C. Treat ends of timber beams and posts exposed to weather by treating with water-repellent preservative in accordance with manufacturer's directions.

3.7 INSTALLATION OF STAIR FRAMING

- A. Provide stair framing members of size, space, and configuration indicated or, if not indicated, to comply with the following requirements:
 - 1. Size: Unless otherwise indicated, 2-by-12-inch nominal size, minimum.
 - 2. Material: solid lumber.
 - 3. Notching: Notch rough carriages to receive treads, risers, and supports; leave at least 5-1/2 inches of effective depth unless otherwise indicated.
 - 4. Spacing: At least three framing members for each 36-inch clear width of stair.
- B. Provide stair framing with no more than 3/16-inch variation between adjacent treads and risers and no more than 3/8-inch variation between largest and smallest treads and risers within each flight.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for testing moisture content levels for all framing lumber and sheathing materials.
 - 2. Testing agency shall immediately report to Architect and Contractor any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, and Contractor within 48 hours of inspections and tests.
 - a. Test reports shall include the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Date and time of field testing.
 - 5) Location in Work.
 - 4. Testing: As follows:
 - a. Conduct testing at minimum five window locations plus 15 additional locations randomly throughout the building. Where project consists of more than one building, minimum testing shall be performed for each building.

3.9 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**SECTION 06 10 00
ROUGH CARPENTRY**

END OF SECTION

**SECTION 06 16 00
SHEATHING**

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
 - 2. Subflooring.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Test Reporting: Moisture content levels of framing lumber and sheathing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

2.2 WALL SHEATHING

- A. Plywood Sheathing: As indicated on the Drawings.
 - 1. Span Rating: Not less than indicated on the Drawings.
 - 2. Nominal Thickness: Not less than indicated on the Drawings.
- B. Oriented-Strand-Board Sheathing: As indicated on the Drawings.
 - 1. Span Rating: Not less than indicated on the Drawings.
 - 2. Nominal Thickness: Not less than indicated on the Drawings.

2.3 SUBFLOORING

- A. Plywood Subflooring: As indicated on the Drawings.
 - 1. Span Rating: Not less than indicated on the Drawings.
 - 2. Nominal Thickness: Not less than indicated on the Drawings.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Nails, Brads, and Staples: As indicated on the Drawings.

2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Verify adhesive has a VOC content of 50 g/L or less.

**SECTION 06 16 00
SHEATHING**

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code, or as indicated on the Drawings.
 - 2. ICC-ES evaluation report for fastener.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Subflooring:
 - a. Glue and nail to wood framing.
 - 2. Wall Sheathing:
 - a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.

3.3 FIELD QUALITY CONTROL

- A. Testing and Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Prepare test and inspection reports.

END OF SECTION

SECTION 06 41 16
PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

SECTION 06 41 16 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plastic-laminate-clad architectural cabinets.
 - 2. Cabinet hardware and accessories.
 - 3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

1.2 DEFINITIONS

- A. Concealed Surfaces of Casework: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of casework installed directly against and completely concealed by walls or other casework, and tops of wall cabinets and utility cabinets.
- B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.
- C. Semiexposed Surfaces of Casework: Surfaces behind opaque doors or drawer fronts, including interior faces of doors, interiors and sides of drawers, and bottoms of wall cabinets.

1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show large-scale details.
 - 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size, unless otherwise indicated below.
 - 1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.
 - a. Provide one sample applied to core material with specified edge material applied to one edge.
 - 2. Thermally Fused Laminate (TFL) Panels: 8 by 10 inches, for each color, pattern, and surface finish.
 - a. Provide edge banding on one edge.
 - 3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For the following:
 - 1. Composite wood products.
 - 2. Thermally fused laminate panels.
 - 3. High-pressure decorative laminate.

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PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- 4. Adhesives.

- 1.6 CLOSEOUT SUBMITTALS
 - A. Maintenance Data: For cabinets to include in maintenance manuals. Include instructions for adjusting door hinges and drawer guides. Include surfaces cleaning instructions.

- 1.7 QUALITY ASSURANCE
 - A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - B. Installer Qualifications: Manufacturer of products.

- 1.8 DELIVERY, STORAGE, AND HANDLING
 - A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

- 1.9 FIELD CONDITIONS
 - A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
 - B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

- 2.1 ARCHITECTURAL CABINET MANUFACTURERS
 - A. Source Limitations: Engage a qualified woodworking firm to assume responsibility for production of architectural cabinets. Obtain from single source from single manufacturer.

- 2.2 CABINETS, GENERAL
 - A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of architectural cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. The Contract Documents contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

- 2.3 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS
 - A. Architectural Woodwork Standards Grade: Custom.
 - B. Type of Construction: Frameless.
 - C. Door and Drawer-Front Style: Flush overlay.
 - D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 - E. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Vertical Surfaces: Grade HGS or VGS.
 - 3. Edges: Grade HGS.

SECTION 06 41 16
PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels, unless otherwise indicated on the Drawings.
- F. Materials for Semiexposed Surfaces:
 1. Surfaces Other Than Drawer Bodies: Thermally fused laminate panels.
 - a. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
 2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
 3. Drawer Bottoms: Hardwood plywood.
- G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 1. As indicated on the Drawings.

2.4 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
 - a. Use Grade M-2-Exterior Glue at all sink cabinets and other wet locations.
 3. Softwood Plywood: DOC PS 1.
 4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
 - a. Color: White.

2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Accuride International](#).
 - b. [Blum, Julius & Co., Inc.](#)
 - c. [CompX International, Inc.](#)
 - d. [Grass America Inc.](#)
 - e. [Knappe & Vogt Manufacturing Company](#).
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening.
- C. Pulls: Edge Pull.
 1. Basis of Design: Amerock, LLC. Edge Pull or equal.
 2. Size: 3-3/4 inch Center to Center.
- D. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- E. Drawer Slides: ANSI/BHMA A156.9.
 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Undermount.
 - a. Type: Full extension.
 - b. Material: Zinc-plated ball bearing slides.
 - c. Motion Feature: Self-closing mechanism.
 2. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50 lb load capacity.

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3. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 100 lb load capacity.
4. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
5. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
6. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
- F. Door Locks: ANSI/BHMA A156.11, E07121.
- G. Drawer Locks: ANSI/BHMA A156.11, E07041.
- H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- I. Grommets for Cable Passage: 1-1/2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Color: Black.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 1. Satin Nickel: ANSI/BHMA 619.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. **Adhesives**: Do not use adhesives that contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Manufacturer's standard meeting VOC requirements.
 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.7 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of casework.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

SECTION 06 41 16
PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. as follows:
 - a. At wood framed walls: No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.
 - b. At metal stud framed walls: No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

**SECTION 07 11 13
BITUMINOUS DAMPPROOFING**

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cold-applied, emulsified-asphalt dampproofing.
 - 2. Molded-sheet drainage panels.

1.2 ACTION SUBMITTALS

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

1.3 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course, drainage panels, and auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

- A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Sika Corporation](#).
 - 2. [Henry Company](#).
 - 3. [W.R. Meadows, Inc.](#)
- B. Brush and Spray Coats: ASTM D1227, Type III, Class 1.

2.4 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D1668/D1668M, Type I.
- D. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

2.5 MOLDED-SHEET PROTECTION / DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage/Protection Panel: Composite subsurface drainage panel acceptable to dampproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft..

SECTION 07 11 13
BITUMINOUS DAMPPROOFING

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sika Corporation.
 - b. Carlisle Coatings & Waterproofing Inc.
 - c. CETCO, a Minerals Technologies company.
 - d. Tremco Incorporated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.
- B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.
- D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
 1. Apply dampproofing to provide continuous plane of protection.
 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
 1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat or one trowel coat at not less than 4 gal./100 sq. ft..

3.5 PROTECTION / DRAINAGE PANEL INSTALLATION

- A. Install protection/drainage panel over completed-and-cured dampproofing. Install panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 1. Support protection/drainage course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.

**SECTION 07 11 13
BITUMINOUS DAMPPROOFING**

3.6 PROTECTION

- A. Protect installed protection/drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where panels are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- B. Correct dampproofing that does not comply with requirements; repair substrates and reapply dampproofing.

END OF SECTION

**SECTION 07 21 00
THERMAL INSULATION**

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket insulation.
- B. Related Requirements:
 - 1. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.
 - 2. Section 13 34 19 "Metal Building Systems" for insulation for new metal building.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Glass-fiber blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
 - 1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
 - 2. Sign, date, and post the certification in a conspicuous location on Project site.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Urea Formaldehyde: Product shall be certified as containing no added urea formaldehyde.
- B. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
 - 1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 - 3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 INSULATION FASTENERS

- A. Wire Supports: Carbon spring steel, minimum 14 gauge.
- B. Strapping: Woven plastic.

**SECTION 07 21 00
THERMAL INSULATION**

2.3 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For wood-framed construction, install blankets according to ASTM C1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formed wall sheet metal fabrications.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 07 95 13.13 "Interior Expansion Joint Cover Assemblies" for manufactured expansion-joint cover assemblies for interior floors, walls, and ceilings.
 - 3. Section 07 95 13.16 "Exterior Expansion Joint Cover Assemblies" for manufactured expansion-joint cover assemblies for exterior building walls, soffits, and parapets.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review requirements for insurance and certificates if applicable.
 - 3. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following
 - 1. Underlayment materials.
 - 2. Elastomeric sealant.
 - 3. Butyl sealant.
 - 4. Epoxy seam sealer.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 - 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 6. Include details of termination points and assemblies.
 - 7. Include details of special conditions.
 - 8. Include details of connections to adjoining work.
 - 9. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

- D. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.
 - E. Sample Warranty: For special warranty.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
 - B. Special warranty.
- 1.7 QUALITY ASSURANCE
- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
 - B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.
- 1.9 WARRANTY
- A. Special Warranty on Factory-Applied Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
 - B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
 - C. SPRI Wind Design Standard: Manufacture and install copings and/or roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
 - D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A755/A755M.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Color: As selected by Architect from manufacturer's full range.
 - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [GCP Applied Technologies Inc.](#)
 - b. [Henry Company.](#)
 - c. [Protecto Wrap Company.](#)
 - 2. Source Limitations: Obtain underlayment from single source from single manufacturer.
 - 3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - 2. Fasteners for Zinc-Coated (Galvanized) and/or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Solder:
 - 1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead with maximum lead content of 0.2 percent.

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SHEET METAL FLASHING AND TRIM

- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- G. Seams:
 - 1. Seams for Un-coated Materials: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 2. Seams for Coated Materials: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- H. Do not use graphite pencils to mark metal surfaces.

2.6 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
 - 1. Galvanized Steel: 0.022 inch thick.

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering, High-Temperature Sheet Underlayment:
 - 1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
 - 2. Prime substrate if recommended by underlayment manufacturer.
 - 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
 - 4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
 - 5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
 - 6. Roll laps and edges with roller.
 - 7. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and/or sealant.
 - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
 - 6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 - 8. Do not field cut sheet metal flashing and trim by torch.
 - 9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - 1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

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2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 3. Use lapped expansion joints only where indicated on Drawings.
 - D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
 - E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
 - F. Seal joints as required for watertight construction.
 1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
 - G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
 1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
 2. Do not solder aluminum sheet.
 3. Do not pretin zinc-tin alloy-coated copper.
 4. Do not use torches for soldering.
 5. Heat surfaces to receive solder, and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.
 6. Stainless Steel Soldering:
 - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
 - b. Promptly remove acid-flux residue from metal after tinning and soldering.
 - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 - H. Rivets: Rivet joints in uncoated aluminum and zinc where necessary for strength.
- 3.4 INSTALLATION OF WALL FLASHINGS
- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
 - B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.
- 3.5 INSTALLATION TOLERANCES
- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- 3.6 CLEANING
- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
 - B. Clean and neutralize flux materials. Clean off excess solder.
 - C. Clean off excess sealants.
- 3.7 PROTECTION
- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
 - B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

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SHEET METAL FLASHING AND TRIM

- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION

SECTION 07 71 29
MANUFACTURED ROOF EXPANSION JOINTS

SECTION 07 71 29 - MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flanged bellows-type roof expansion joints.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wooden curbs or cants for mounting roof expansion joints.
 - 2. Section 07 62 00 "Sheet Metal Flashing and Trim" for shop- and field-fabricated sheet metal flashing, and other sheet metal items.
 - 3. Section 07 95 13.13 "Interior Expansion Joint Cover Assemblies" and Section 07 95 13.16 "Exterior Expansion Joint Cover Assemblies for wall expansion joints.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roof expansion joints.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of splices, intersections, transitions, fittings, method of field assembly, and location and size of each field splice.
 - 3. Provide isometric drawings of intersections, terminations, changes in joint direction or planes, and transition to other expansion joint systems depicting how components interconnect with each other and adjacent construction to allow movement and achieve waterproof continuity.
- C. Samples: For each exposed product and for each color specified, 6 inches in size.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For special warranties.

1.5 WARRANTY

- A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof expansion joints that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

SECTION 07 71 29
MANUFACTURED ROOF EXPANSION JOINTS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint seals, failure of connections, and other detrimental effects.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 FLANGED BELLOWS-TYPE ROOF EXPANSION JOINTS

- A. Flanged Bellows-Type Roof Expansion Joint: Factory-fabricated, continuous, waterproof, joint cover consisting of exposed membrane bellows laminated to flexible, closed-cell support foam, and secured along each edge to 3- to 4-inch-wide metal flange.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Construction Specialties, Inc.
 2. Product: Construction Specialties, Inc., SRJW-600.
 3. Source Limitations: Obtain flanged bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
 4. Joint Movement Capability: Plus and minus As indicated on Drawings.
 5. Bellows: EPDM flexible membrane.
 6. Flanges: Aluminum, 0.032 inch thick.
 7. Configuration: As indicated on Drawings.
 8. Corner, Intersection, and Transition Units: Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints.
 9. Cover: Extruded aluminum covering entire joint assembly and curb.
 - a. Finish: High-Performance Organic Finish by Manufacturer, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
 - b. Color: As selected by the Architect from the manufacturer's full range of options.
 10. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.
 - a. Thermal Vapor Barrier and Insulation: Fill space below bellow with manufacturer's standard, factory-installed formaldehyde-free insulation blanket; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84.
 - 1) Product: Construction Specialties, Inc. Thermal Vapor Barrier (TVB), R-30.
- B. Materials:
1. Aluminum Sheet: ASTM B209, mill finish, with temper to suit forming operations and performance required.
 2. EPDM Membrane: ASTM D4637/D4637M, type standard with manufacturer for application.
 3. Neoprene Membrane: Neoprene sheet recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil; and as standard with roof-expansion-joint manufacturer for application.

2.3 MISCELLANEOUS MATERIALS

- A. Adhesives: As recommended by roof-expansion-joint manufacturer.
- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.
- C. Glass-Fiber Blanket Insulation: ASTM C665.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

SECTION 07 71 29
MANUFACTURED ROOF EXPANSION JOINTS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joint openings, substrates, and expansion-control joint systems that interface with roof expansion joints, for suitable conditions where roof expansion joints will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for handling and installing roof expansion joints.
 - 1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
 - 2. Install roof expansion joints true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 3. Provide for linear thermal expansion of roof expansion joint materials.
 - 4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
 - 5. Provide uniform, neat seams.
 - 6. Install roof expansion joints to fit substrates and to result in watertight performance.
- B. Directional Changes: Install factory-fabricated units at directional changes to provide continuous, uninterrupted, and watertight joints.
- C. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.
- D. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

END OF SECTION

**SECTION 07 84 13
PENETRATION FIRESTOPPING**

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetration firestopping systems for the following applications:
 - a. Penetrations in fire-resistance-rated walls.
- B. Related Requirements:
 - 1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. [Product Data](#): For sealants, indicating VOC content.
- C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
- D. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

SECTION 07 84 13
PENETRATION FIRESTOPPING

2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Product iQ™"
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Approval in its "Approval Guide."
 - B. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
 - C. When intumescent products are used, provide products that do not contain sodium silicate or any other water-soluble intumescent ingredient in the formulation.
 - D. Provide firestop products that do not contain ethylene glycol.
 - E. Provide firestop sealants sufficiently flexible to accommodate movement such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
 - F. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.
 - G. Dissimilar Materials: Noncombustible penetrating items shall not connect to combustible items beyond the point of firestopping unless it can be demonstrated that the fire-resistance integrity of the wall is maintained.
 - H. Cable Pathway Devices: For penetrations of data, video and communications cables in all locations where frequent cable moves, adds or changes will occur, provide fire-rated pathway devices with a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier penetrated and automatically adjust to the cable loading and permit cables to be installed, removed, or retrofitted without the need to remove or reinstall any firestop materials.
 1. Capable of retrofit around existing cables;
 2. Designed such that two or more devices can be ganged together;
 3. Maintenance-free such that no action is required to activate the smoke and fire sealing mechanism.
 - I. When cable pathway devices are not practical, openings within walls and floors designed to accommodate data, video and communications cabling shall be provided with re-enterable products specifically designed for retrofit.
 - J. Fire-Rated Cable Sleeve Kits: When used, provide complete kits designed for new or existing cable penetrations through walls, which include a precut metallic sleeve, end caps to prevent sharp edges, mounting escutcheons, intumescent escutcheon gaskets, firestop putty and wall warning labels, and are sized to same O.D. as standard EMT (Electrical Mechanical Tubing) to accept standard accessories.
 - K. Thermal Wrap: For fire protection of membrane penetrations of utility boxes, electrical circuits, and exposed fuel lines, provide a flexible protective wrap which, when exposed to fire, releases chemically bound water to have a cooling effect (endothermic); and is tested and listed for up to 2-hour fire ratings in accordance with ASTM E814/UL 1479 for membrane penetrations or ASTM E1725/UL1724 for thermal barrier, circuit integrity and fuel line protection.

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. Specified Technologies, Inc.

SECTION 07 84 13
PENETRATION FIRESTOPPING

- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
 - 1. **Verify sealant has a VOC** content of 50 g/L or less.
- E. Manufactured Piping Penetration Firestopping System: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
 - 4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 5. Stack Fitting: ASTM A48/A48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 6. Special Coating: Corrosion resistant on interior of fittings.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component, intumescent, latex formulations that do not re-emulsify after cure during exposure to moisture, and do not contain water soluble intumescent ingredients.
- C. Endothermic Sealants: Single component latex formulations which, when exposed to fire, absorb heat and release water vapor.
- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- F. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.
- H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable, non-curing, compressible, intumescent pillows/bags. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

SECTION 07 84 13
PENETRATION FIRESTOPPING

- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
- L. Fire-Rated Cable Pathways: Factory-made, gangable, device modules comprised of a steel raceway with built-in intumescent material allowing 0 to 100 percent visual cable fill and requiring no additional products or action in the form of plugs, twisting closure, putty, pillow, or sealant or otherwise to achieve fire and air leakage ratings, and capable of being retrofitted around existing cables.
- M. Cable Sleeve Retrofit Device: Factory-made, intumescent, two-part hinged device for firestopping existing over-filled cable sleeves.
- N. Fire-Rated Cable Sleeve Kits: Complete kits for new or existing cable penetrations consisting of preformed steel sleeve with rolled edges, steel escutcheon plates with intumescent gaskets, and firestop putty.
- O. Wall Opening Protective Materials ("Putty Pads"): Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes.
- P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use around rectangular steel HVAC ducts without fire dampers.
- Q. Firestop Plugs: Re-enterable foam rubber plug impregnated with intumescent material for use in blank openings and cable sleeves.
- R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer with a foam inner core for sealing cable penetrations up to 0.5 in. diameter through gypsum walls.
- S. Fire-Rated Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a closet (toilet) flange in floor applications.
- T. Thermal Wrap: Flexible, endothermic, fire-resistant wrap material for protecting membrane penetrations of utility boxes (electrical panels, medical gas boxes, elevator call boxes), electrical circuits (cables, conduits, cable trays), and exposed fuel lines.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

SECTION 07 84 13
PENETRATION FIRESTOPPING

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION

**SECTION 07 84 43
JOINT FIRESTOPPING**

SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
- B. Related Requirements:
 - 1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. [Product Data](#): For sealants, indicating VOC content.
- C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
- D. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:

**SECTION 07 84 43
JOINT FIRESTOPPING**

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
- B. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
- C. When intumescent products are used, provide products that do not contain sodium silicate or any other water-soluble intumescent ingredient in the formulation.
- D. Provide firestop products that do not contain ethylene glycol.
- E. Provide firestop sealants sufficiently flexible to accommodate movement such as wind, thermal expansion and other normal building movement without damage to the seal.
- F. Rain/Water Resistance: Where inclement weather or greater-than-transient water exposure is expected, use products which dry rapidly and cure in the presence of atmospheric moisture sufficient to pass ASTM D6904 early rain resistance test (24-hour exposure).
- G. Where intumescent gaskets are applied to steel framing prior to framing installation, provide products with fire, smoke and acoustical ratings which allow movement up to 100% compression and/or extension in accordance with UL 2079 or ASTM E1966; have an L Rating < 1 cfm/linear foot in accordance with UL 2079; and have a minimum Sound Transmission Class (STC) rating of 50 in accordance with ASTM E90/ASTM C919.
- H. For aluminum curtain wall systems with one or two-piece rectangular mullions at least 2-1/2 in. x 5 in., provide perimeter fire barrier system which does not require direct screw attachment to support and fasten curtain wall insulation and is tested in accordance with ASTM E2307 for up to 2 hour fire resistance and ASTM E1233 for wind cycling.

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. Specified Technologies, Inc.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
 1. Verify sealant has a VOC content of 50 g/L or less.

2.3 JOINT FIRESTOPPING PRODUCTS

- A. Elastomeric Sealants: Single component latex formulations which accommodate minimum ±25 percent movement for 500 cycles per UL2079 or ASTM E1399.
- B. All-Weather Coatings: Moisture curing, single component silicone copolymer elastomeric spray coating for horizontal surfaces where greater water resistance is required or inclement weather is anticipated.
- C. Perimeter Fire Barrier Spray Coating: Single component, water-based, non-halogenated elastomeric coating containing no volatile solvents, inorganic fibers, or asbestos.
- D. Endothermic Sealants: Single component latex formulations which, when exposed to fire, absorb heat and release water vapor, resisting the progress of smoke and flame.

SECTION 07 84 43
JOINT FIRESTOPPING

- E. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealants for horizontal surfaces (self-leveling or non-sag) or vertical joints (non-sag).
- F. Intumescent Gaskets: Intumescent cover for gypsum wall framing with pressure sensitive adhesive; capable of +/- 100 percent joint movement.
- G. High-movement joint profile: High temperature fibrous joint forming material for use in head-of-wall construction joints in conjunction with firestop coating and allowing up to 100-percent movement in compression and extension.
- H. For aluminum curtain wall systems with one or two-piece rectangular mullions at least 2-1/2 in. x 5 in., provide perimeter fire barrier system which, for the majority of applications, does not require direct screw attachment to install curtain wall insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition may occur such as the intersection of a gypsum wallboard/steel stud wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

3.3 INSTALLATION

- A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

**SECTION 07 84 43
JOINT FIRESTOPPING**

- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

END OF SECTION

**SECTION 07 92 00
JOINT SEALANTS**

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Nonstaining silicone joint sealants.
 - 3. Urethane joint sealants.
 - 4. Immersible joint sealants.
 - 5. Mildew-resistant joint sealants.
 - 6. Butyl joint sealants.
 - 7. Latex joint sealants.
- B. Related Requirements:
 - 1. Division 32 for sealing joints in paved roads, parking lots, walkways, and curbing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency and/or a qualified testing agency.
- C. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- D. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 - 1. Joint-sealant location and designation.
 - 2. Manufacturer and product name.
 - 3. Type of substrate material.
 - 4. Proposed test.
 - 5. Number of samples required.
- E. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- F. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- G. Field-Adhesion-Test Reports: For each sealant application tested.
- H. Sample Warranties: For special warranties.

**SECTION 07 92 00
JOINT SEALANTS**

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing for Structural Glazing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 - 6. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each kind of sealant and joint substrate.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 - 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

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1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion for urethanes and Twenty years from date of Substantial Completion for silicones.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content: Verify sealants and sealant primers comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Sealants and Caulking: 50 g/L.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BASF.
 - 2. Bostik.
 - 3. Dow.
 - 4. GE Construction Sealants.
 - 5. Sika Corporation.
 - 6. Tremco Incorporated.

2.3 SOURCE LIMITATIONS

- A. For all joint sealants used at exterior weather envelope of building, obtain products from single manufacturer. Alternatively, when multiple manufacturers are utilized, written documentation must be provided for compatibility between products proposed.

2.4 SILICONE JOINT SEALANTS

- A. JS-1: Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
- B. JS-2: Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
- C. JS-3: Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT.

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- D. JS-4: Silicone, S, P or NS, 100/50, T, NT: Single-component, pourable or nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P or NS, Class 100/50, Uses T.

2.5 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. JS-5: Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
- C. JS-6: Silicone, Nonstaining, S, NS, 50, T: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use T.

2.6 URETHANE JOINT SEALANTS

- A. JS-7: Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. JS-8: Urethane, S, NS or P, 100/50, T, NT: Single-component, nonsag or pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS or P, Class 100/50, Uses T and NT.
- C. JS-9: Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T and NT.
- D. JS-10: Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.
- E. JS-11: Urethane, S, NS, 100/50, T, NT, I: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, immersible, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT, I. Substrate primer as required by manufacturer for immersible application.
- F. JS-12: Urethane, S, NS, 50, T: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T.

2.7 SILYL-TERMINATED POLYETHER (STPE) JOINT SEALANTS

- A. JS-13: STPE, S, NS, 35, NT: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability, nontraffic-use, silyl-terminated polyether joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT.

2.8 BUTYL JOINT SEALANTS

- A. JS-14: Butyl-Rubber-Based Joint Sealants: ASTM C1311.

2.9 LATEX JOINT SEALANTS

- A. JS-15: Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.10 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

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2.11 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - e. Stone.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
 - e. Pre-painted surfaces.
 - f. Plastics.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

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3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.
 - 4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were

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primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

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

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. The following Joint-Sealant Schedule is prescriptive based on material(s) that joint sealants will be applied to. It shall be the sole responsibility of the sealant installer to verify suitability of each sealant type for intended application and bonding substrate. Notify Architect of unsuitable conditions prior to application.
- B. Color: Color of sealant shall match that of adjacent material unless otherwise directed by the Architect. Where joint occurs between two different colored surfaces, consult Architect for direction on color selection.
- C. **JS-1:** Joint-Sealant Application: Exterior joints in vertical surfaces subject to significant movement.
 1. Joint Locations:
 - a. Joints between masonry, metal and concrete not scheduled for field-painting.
 - b. Joints between pre-finished siding products not scheduled for field-painting.
 - c. Joints at aluminum curtainwall and storefront, and window perimeters.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, S, NS, 100/50, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. **JS-2:** Joint-Sealant Application: Glazing sealant and exterior joints in vertical surfaces subject to moderate movement.
 1. Joint Locations:
 - a. Exterior and interior glazing sealant.
 - b. Exterior non-porous surfaces such as metal, glass and pre-finished materials.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, S, NS, 50, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. **JS-3:** Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints at wet locations such as bathrooms, shower rooms, restrooms, kitchens, etc.
 - c. All other joints between glass, metal, porcelain, ceramic and most painted surfaces where sealing for sanitary conditions is required.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.

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- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. **JS-4a:** Joint-Sealant Application: Exterior joints in horizontal traffic surfaces, non-sag type.
 - 1. Joint Locations:
 - a. Control and expansion joints in traffic surfaces such as concrete, brick, stone, etc.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints in parking structures and roadways.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, S, NS, 100/50, T.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. **JS-4b:** Joint-Sealant Application: Exterior joints in horizontal traffic surfaces, pourable self-leveling type.
 - 1. Joint Locations:
 - a. Control and expansion joints in traffic surfaces such as concrete, brick, stone, etc.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints in parking structures and roadways.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, S, P, 100/50, T or NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- H. **JS-5:** Joint-Sealant Application: Non-staining exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Joints at porous materials such as marble, terracotta, exterior insulation and finish systems (EFIS), etc. that are susceptible to surface staining.
 - b. Joints in dimension stone cladding.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - e. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, Non-Staining, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- I. **JS-6:** Joint-Sealant Application: Non-staining interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in stone flooring.
 - b. Control and expansion joints in brick flooring.
 - c. Control and expansion joints in porous tile flooring.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, Non-Staining, S, NS, 50, T.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- J. **JS-7:** Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces subject to minimal movement.
 - 1. Joint Locations:
 - a. Joints subject to minimal movement in metal joinery, roof copings, parapets.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- K. **JS-8a:** Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to significant movement.
 - 1. Joint Locations:
 - a. Control and expansion joints in traffic surfaces such as concrete, brick, stone, etc.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 100/50, T or NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- L. **JS-8b:** Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to significant movement.
 - 1. Joint Locations:

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- a. Control and expansion joints in traffic surfaces such as concrete, brick, stone, etc.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints in swimming pool decks.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, P, 100/50, T or NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- M. **JS-9:** Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces subject to minimal movement.
- 1. Joint Locations:
 - a. Vertical joints between pre-cast concrete tilt panels.
 - b. Vertical joints in masonry.
 - c. Vertical and sloping joints in cold fluid-applied waterproofing.
 - d. Joints where a large color selection is required.
 - e. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, M, NS, 50, T or NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- N. **JS-10:** Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to minimal movement.
- 1. Joint Locations:
 - a. Control and expansion joints in traffic surfaces such as concrete, brick, stone, etc.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Horizontal joints in cold fluid-applied waterproofing.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, M, P, 25, T and NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- O. **JS-11:** Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.
- 1. Joint Locations:
 - a. Joints in swimming pool decks.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, immersible, S, NS, 100/50, T, I.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- P. **JS-12:** Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
- 1. Joint Locations:
 - a. Control and expansion joints in non-porous tile flooring.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 50, T.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- Q. **JS-13:** Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces subject to moderate movement.
- 1. Joint Locations:
 - a. Vertical joints at fiber-cement siding.
 - b. Vertical joints between wood, masonry, concrete and metal that is scheduled for field-painting
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: STPE, S, NS, 35, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- R. **JS-14:** Joint-Sealant Application: Concealed mastics.
- 1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Butyl-rubber based.
 - 3. Joint-Sealant Color: Black, unless noted otherwise on the Drawings.
- S. **JS-15:** Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

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1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Joints between trim and walls at painted locations. Commonly called "Painter's Caulk."
 - d. Other joints as indicated on Drawings.
2. Joint Sealant: Acrylic latex or siliconized acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 07 95 13.13
INTERIOR EXPANSION JOINT COVER ASSEMBLIES

SECTION 07 95 13.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall expansion joint covers.

1.2 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
 - 1. Wall expansion joint covers.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples: For each expansion joint cover assembly and for each color and texture specified, full width by 6 inches long in size.
- D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion joint cover assembly.
 - 2. Expansion joint cover assembly location cross-referenced to Drawings.
 - 3. Nominal, minimum, and maximum joint width.
 - 4. Movement direction.
 - 5. Materials, colors, and finishes.
 - 6. Product options.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Expansion joint cover assemblies to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Expansion Joint Design Criteria:
 - 1. Type of Movement: Thermal.
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Minimum Joint Width: As indicated on Drawings.
 - c. Maximum Joint Width: As indicated on Drawings.
 - 2. Seismic Movement:
 - a. Joint Movement: As indicated on Drawings.

2.3 WALL EXPANSION JOINT COVERS

- A. Elastomeric-Seal Wall Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
 - a. **Construction Specialties, Inc.**

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2. Product: Construction Specialties, Inc. FWS-600M.
3. Application: Wall to wall.
4. Exposed Metal:
 - a. Aluminum: Manufacturer's standard.
5. Seal: Preformed elastomeric membranes or extrusions.
 - a. Color: As selected by Architect from manufacturer's full range.

2.4 MATERIALS

- A. Aluminum: ASTM B221, Alloy 6063-T5 for extrusions; ASTM B209, Alloy 6061-T6 for sheet and plate.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

2.5 ALUMINUM FINISHES

- A. Mill finish.

2.6 ACCESSORIES

- A. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 1. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 2. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 3. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 4. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

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INTERIOR EXPANSION JOINT COVER ASSEMBLIES

- C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
- E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION

SECTION 07 95 13.16
EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

SECTION 07 95 13.16 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior expansion joint covers.

1.2 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
 - 1. Exterior expansion joint covers.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples: For each exposed expansion joint cover assembly and for each color and texture specified, full width by 6 inches long in size.
- D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion joint cover assembly.
 - 2. Expansion joint cover assembly location cross-referenced to Drawings.
 - 3. Nominal, minimum, and maximum joint width.
 - 4. Movement direction.
 - 5. Materials, colors, and finishes.
 - 6. Product options.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Expansion Joint Design Criteria:
 - 1. Type of Movement: Thermal.
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Minimum Joint Width: As indicated on Drawings.
 - c. Maximum Joint Width: As indicated on Drawings.
 - 2. Seismic Movement:
 - a. Joint Movement: As indicated on Drawings.

2.3 EXTERIOR EXPANSION JOINT COVERS

- A. Exterior Elastomeric-Seal Joint Cover: Assembly consisting of elastomeric seal anchored to surface-mounted frames fixed to sides of joint gap.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
 - a. **Construction Specialties, Inc.**

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EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

2. Product: Construction Specialties, Inc. SF-600.
3. Application: Wall to wall.
4. Installation: Surface-mounted.
5. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I.
6. Seal: Preformed elastomeric membrane or extrusion.
 - a. Color: As selected by Architect from manufacturer's full range.
7. Secondary Gasket: PVC gasket.

2.4 MATERIALS

- A. Aluminum: ASTM B221, Alloy 6063-T5 for extrusions; ASTM B209, Alloy 6061-T6 for sheet and plate.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes and PVC gasket to be installed in metal frames.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.6 ACCESSORIES

- A. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 4. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.

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EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

- 5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
 - C. Elastomeric and PVC Seals: Install elastomeric and PVC seals in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
 - D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
 - E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- 3.4 CONNECTIONS
- A. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall expansion joint covers with roof expansion joint covers specified in Section 07 71 29 "Manufactured Roof Expansion Joints."
- 3.5 PROTECTION
- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
 - B. Protect the installation from damage by work of other Sections.

END OF SECTION

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior standard steel doors and frames.
 - 3. Borrowed lites.
- B. Related Requirements:
 - 1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.
 - 2. Section 08 80 00 "Glazing" for glass and glazing in hollow-metal doors and frames.

1.2 DEFINITIONS

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

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
- C. Samples for Verification:
 - 1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
 - 1. Submit copy of DHI Fire Door Assembly Inspector (FDAI) certificate.
- B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly, and thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.
- C. Field quality control reports.
- D. Sample Warranty: For special warranty.

**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

1.6 CLOSEOUT SUBMITTALS

- A. Special warranties.
- B. Record Documents: For fire-rated doors and smoke-rated doors, list of door numbers and applicable room name and number to which door accesses.
- C. Requirements for fire-rated, smoke-rated and egress doors yearly maintenance and inspection services for Owner per NFPA 80, NFPA 105 and NFPA 101.

1.7 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jamb and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Hollow-Metal Doors and Frames: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door; AADG, Inc.; ASSA ABLOY.
 - 2. Curries, AADG, Inc.; ASSA ABLOY Group.
 - 3. Republic Doors and Frames; a Allegion brand.
 - 4. Steelcraft; Allegion plc.
 - 5. Stiles Custom Metal, Inc.
- B. Source Limitations: Obtain hollow metal doors and frames of each type from a single source from a single manufacturer.
 - 1. Openings with both fire-rated hollow metal doors and frames shall be provided by the same manufacturer, unless otherwise indicated.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Thermally Rated Door-Frame Assemblies:
 - 1. Provide opening assemblies with U-factor of not more than 0.37 deg Btu/F x h x sq. ft. when tested according to ASTM C1363 or ASTM E1423.
- C. Air Infiltration for Exterior Doors: Provide door assemblies tested for air leakage at 1.57 lbs. per sq. ft. in accordance with ASTM E283. Air leakage shall not exceed 1.00 cu. ft. per minute per sq. ft. of door area.

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

- D. Water Infiltration for Exterior Doors: Provide door assemblies with no uncontrolled leakage when tested in accordance with ASTM E331 at test pressure of 6.24 lbs. per sq. ft.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.
1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch (nominal 16-gauge).
 - d. Edge Construction: Model 2, Seamless.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Core: Manufacturer's standard.
 - g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener and/or laminated mineral board core for fire-rated and temperature-rise-rated doors.
 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (nominal 16-gauge).
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Face welded.
 3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Maximum-Duty Doors and Frames: ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.
1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch (nominal 14-gauge, with minimum A60 coating).
 - d. Edge Construction: Model 2, Seamless.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - h. Core: Manufacturer's standard.
 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (nominal 14-gauge, with minimum A60 coating). Provide manufacturer's thermal break in frame profile.
 - b. Construction: Full profile welded.
 - c. Profile: Manufacturer's standard for wall material, condition and thickness. At framed wall locations, fabricate with integral "nail-fin" for weatherproofing.
 3. Exposed Finish: Prime.

2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.

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- B. Construction: Face welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.7 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- H. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

2.8 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

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HOLLOW METAL DOORS AND FRAMES

- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 1. Provide stops and moldings flush with face of door, and with **[beveled]** **[square]** stops unless otherwise indicated.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames according to NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

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HOLLOW METAL DOORS AND FRAMES**

- a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
- 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- 1. Inspection agency shall be third-party to the Contractor, door hardware supplier and/or door hardware installer.
- B. Inspections:
- 1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 31 13
ACCESS DOORS AND FRAMES

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.
- B. Related Requirements:
 - 1. Division 23 for heating and air-conditioning duct access doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.
- C. Product Schedule: For access doors and frames.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspecting agency.
 - 1. Submit copy of DHI Fire and Smoke Door Assembly Inspector (FDAI) certificate.
- B. Field quality control reports.
- C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace access doors and frames that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Access Doors and Frames: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Activar Construction Products Group, Inc. - JL Industries.
 - 2. ACUDOR Products, Inc.
 - 3. Karp Associates, Inc.
 - 4. Milcor; a division of Hart & Cooley, Inc.

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5. [Nystrom](#).
- B. **AD-1:** Flush Access Doors with Exposed Flanges:
 1. Description: Face of door flush with frame, with exposed flange and concealed hinge. Basis-of-Design: Acudor UF-5000.
 2. Locations: Wall and ceiling.
 3. Door Size: As required for application. Not less than 22-inches by 30-inches where full body access is required.
 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory finished.
 5. Frame Material: Same material, thickness, and finish as door.
 6. Latch and Lock: Cylinder lock, key operated.
- C. **AD-2:** Flush Access Doors with Concealed Flanges:
 1. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge. Basis-of-Design: Acudor DW-5040.
 2. Locations: Wall and ceiling.
 3. Door Size: As required for application. Not less than 22-inches by 30-inches where full body access is required.
 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory finished.
 5. Frame Material: Same material and thickness as door.
 6. Latch and Lock: Cylinder lock, key operated.
- D. **AD-3:** Recessed Access Doors with Concealed Flanges:
 1. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge. Basis-of-Design: Acudor DW-5015.
 2. Locations: Wall and ceiling.
 3. Door Size: As required for application. Not less than 22-inches by 30-inches where full body access is required.
 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory finished.
 5. Latch and Lock: Cylinder lock, key operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

- A. **AD-4:** Fire-Rated, Flush Access Doors with Exposed Flanges:
 1. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge. Basis-of-Design: Acudor FB-5060.
 2. Locations: Wall.
 3. Door Size: As required for application. Not less than 22-inches by 30-inches where full body access is required.
 4. Fire-Resistance Rating: Not less than that of adjacent construction.
 5. Temperature-Rise Rating: 450 deg F at the end of 30 minutes.
 6. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory finished.
 7. Frame Material: Same material, thickness, and finish as door.
 8. Latch and Lock: Self-closing, self-latching door hardware, cylinder lock, key operated.
- B. **AD-5:** Fire-Rated, Flush Access Doors with Concealed Flanges:
 1. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge. Basis-of-Design: Acudor FW-5015 (walls) and FWC-5015 (ceilings).
 2. Locations: Wall and ceiling.
 3. Door Size: As required for application. Not less than 22-inches by 30-inches where full body access is required.
 4. Fire-Resistance Rating: Not less than that of adjacent construction.
 5. Temperature-Rise Rating: 450 deg F at the end of 30 minutes.
 6. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory finished.
 7. Frame Material: Same material, thickness, and finish as door.
 8. Latch and Lock: Self-closing, self-latching door hardware, cylinder lock, key operated.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

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ACCESS DOORS AND FRAMES

- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
 - 1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.
- E. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.
 - a. Color: See Access Doors and Frames Schedule below.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

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

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ACCESS DOORS AND FRAMES

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80.

3.4 ADJUSTING

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

3.5 ACCESS DOORS AND FRAMES SCHEDULE

- A. The following Access Doors and Frames Schedule is prescriptive based on door location, visual aesthetic and fire rating.
- B. **AD-1:** Flush Access Doors with Exposed Flanges:
 - 1. Door Locations:
 - a. Non-public locations, concealed from public view; mechanical rooms, electrical rooms, janitor closets, storage closets, etc.
 - 2. Color: Gray.
- C. **AD-2:** Flush Access Doors with Concealed Flanges:
 - 1. Door Locations:
 - a. Semi-public locations, within public view; rooms, offices, bedrooms, etc.
 - 2. Color: White.
- D. **AD-3:** Recessed Access Doors with Concealed Flanges:
 - 1. Door Locations:
 - a. Public locations, within public view; vestibules, lobbies, hallways, meeting rooms, dining rooms, restrooms, bathrooms, etc.
 - 2. Color: Gray.
- E. **AD-4:** Fire-Rated, Flush Access Doors with Exposed Flanges:
 - 1. Door Locations:
 - a. Non-public, fire-rated locations, concealed from public view; mechanical rooms, electrical rooms, janitor closets, storage closets, etc.
 - 2. Color: Gray.
- F. **AD-5:** Fire-Rated, Flush Access Doors with Concealed Flanges:
 - 1. Door Locations:
 - a. Public and Semi-Public, fire-rated locations, within public view; vestibules, lobbies, hallways, meeting rooms, dining rooms, restrooms, bathrooms, rooms, offices, bedrooms, etc.
 - 2. Color: White.

END OF SECTION

SECTION 08 36 13
SECTIONAL DOORS

SECTION 08 36 13 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electrically operated sectional doors.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.
 - 2. Section 13 34 19 "Metal Building Systems" for new building sectional door will be installed.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied finishes.
 - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
 - 1. Flat door sections.
 - 2. Frame for paneled door sections; of each width of stile and rail required.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.

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- e. Delamination of exterior or interior facing materials.
- 2. Warranty Period: Two years or 300,000 cycles from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion for powder coating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
 - 1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Testing: According to ASTM E330 or DASMA 108 for garage doors and complying with the acceptance criteria of DASMA 108.
 - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
 - b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.
- C. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.0.

2.3 GLAZED DOOR ASSEMBLY

- A. Full-Vision Aluminum Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Clopay Building Products.
 - b. Overhead Door Corporation.
 - c. Raynor.
 - d. Wayne-Dalton Corp.
 - 2. Basis-of-Design: Overhead Door Corporation - Model 521s Aluminum Glass Door
- B. Operation Cycles: Door components and operators capable of operating for not less than 300,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.
- D. Installed R-Value: 4.5 deg F x h x sq. ft./Btu.
- E. Aluminum Sections: Full vision.
- F. Track Configuration: Standard-lift track.
- G. Weatherseals: Fitted to bottom and top and around entire perimeter of door.
- H. Roller-Tire Material: Manufacturer's standard.
- I. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: locking bars, operable from inside and outside, with cylinders.
- J. Electric Door Operator:
 - 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
 - 2. Operator Type: Manufacturer's standard for door requirements.

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3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
 4. Motor Exposure: Interior, clean, and dry.
 5. Emergency Manual Operation: Chain type.
 6. Obstruction-Detection Device: Automatic electric sensor edge on bottom section.
 - a. Sensor Edge Bulb Color: Black.
 7. Control Station: Interior-side mounted 3-button controller for open, close, and stop motion functions.
- K. Door Finish:
1. Powder-Coat Finish: Color and gloss as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 ALUMINUM DOOR SECTIONS

- A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, 1/4-inch-minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.
1. Aluminum: ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; minimum thickness 0.065 inch for door section 1-3/4 inches deep, and as required to comply with requirements.
 2. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading.
 3. Provide reinforcement for hardware attachment.
- B. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 1/2-inch-thick, obscure insulated glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.
1. Glass Finish: Manufacturer's Satin Etched.

2.6 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
1. Galvanized Steel: ASTM A653/A653M, minimum G60 zinc coating.
 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
 - a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets or Intermittent, jamb brackets attached to track and attached to wall.
 - b. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.
- C. Windows: Manufacturer's standard window units of type, size, and in arrangement indicated. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors and elastic glazing

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compound for wood doors, as required. Provide removable stops of same material as door-section frames.

2.7 HARDWARE

- A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch-nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet wide unless otherwise recommended by door manufacturer.
- C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch-diameter roller tires for 3-inch-wide track and 2-inch-diameter roller tires for 2-inch-wide track.

2.8 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Cylinders standard with manufacturer.
 - 2. Keys: Two for each cylinder.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.9 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
 - 1. Trolley: Trolley operator mounted to ceiling above and to rear of door in raised position and directly connected to door with drawbar.
 - 2. Jackshaft, Center Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.
 - 3. Jackshaft, Side Mounted: Jackshaft operator mounted on the inside front wall on right or left side of door and connected to torsion shaft with an adjustable coupling or drive chain.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
 - 1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115 V.
 - c. Hertz: 60.
 - 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

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5. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom section. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."
 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

- A. Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal

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bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.

- b. 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.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
5. Key Schedule:
- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. 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.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. 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.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
- 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 - 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
- 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
 - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, 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.
2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. 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.
3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
 - a. 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.

C. Pre-Installation Meetings

1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. 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.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. 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.
- E. 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.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 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.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) Schlage ND Series: 10 years
 - 2) Closers
 - a) LCN 4000 Series: 30 years
 - b) LCN 1460 Series: 30 years

1.08 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. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- 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 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed 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 wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. 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.

C. Cable and Connectors:

1. 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.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. 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 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
2. Acceptable Manufacturers and Products:
 - a. McKinney TB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage ND series
2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
 - a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
 - b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
 - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
 - d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
 - e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.

3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
 - b. Lever Design: <RHO>.

2.05 ELECTRONIC ACCESS CONTROL LOCKSETS AND EXIT DEVICE TRIM

A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Schlage CO Series
2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide offline electronic access control products that comply with the following requirements:
 - a. Listed, UL 294 - The Standard of Safety for Access Control System Units.
 - b. Compliant with ANSI/BHMA A156.25 Grade 1 Operation and Security.
 - c. Certified to UL10C, FCC Part15, Florida Building Code Standards TAS 201 large missile impact, TAS 202 and TAS 203.
 - d. Compliant with ASTM E330 for door assemblies.
 - e. Compliant with ICC / ANSI A117.1, NFPA 101, NFPA 80, and Industry Canada RSS-210.
2. Functions: Provide functions as scheduled that are field configurable without taking the offline electronic product off the door.
3. Emergency Override: Provide mechanical key override; cylinders: Refer to "KEYING" article, herein.
4. Levers:
 - a. Vandal Resistance: Exterior (secure side) lever rotates freely while door remains locked, preventing damage to internal lock components from vandalism by excessive force.
 - b. Provide pressure cast zinc plated, non-handed lever trim that operates independently of non-locking levers.
 - c. Style: <RHO>.
5. Power Supply: 4 AA batteries
 - a. Provide electronic access control locks and/or exit device trim with the ability to communicate battery status.
6. Features:
 - a. Visual tri-colored LED indicators that indicate activation, operational systems status, system error conditions and low power conditions.

- b. Visual bi-colored LED indicator on interior that can indicate secured/unsecured status of device to occupants on interior.
 - c. Audible feedback that can be enabled or disabled.
 - d. Onboard processor with memory capacity of 2,000 event audit history, up to 16 time zones and up to 32 calendar events.
 - e. Central verification time of less than 1 second
 - f. Tamper-Resistant Screws: Tamper torx screws on inside escutcheon for increased security.
 - g. Lockdown Function: (CO-220 ONLY)
 - 1) Provide electronic access control locks and/or exit device trim with remote lockdown function.
 - 2) Provide at least 1 Remote Lockdown Fob to be paired with each lock.
 - 3) Provide electronic access control locks and/or exit device trim with lockdown function capable of being paired with up to 10 Remote Lockdown Fobs. Provide Remote Lockdown Fob capable of being paired with up to 10 locks. Provide Remote Lockdown Fob with one button to initiate lockdown with paired lock and a separate button to reset locks that are paired to it from lockdown. Provide Remote Lockdown Fobs with range of up to 75 feet on secured side and up to 25 feet on exterior side of door based upon typical building construction.
 - 4) Free egress to be maintained in this mode. Only fob, key, or administrative/safety official credentials to be able to override lock from secure side in this mode.
7. Access:
- a. Programmable Keypad
 - 1) 3-6-digit PIN code and 12 backlit buttons in a 3 x 4 matrix.
8. Operation:
- a. Provide electronic access control locks and/or exit device trim with the ability to be configured at door by handheld programming device the length of time device is unlocked upon access grant.
 - b. Provide electronic access control locks and/or exit device trim with the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device.
9. Programming Means:
- a. Product: Schlage HHD series with Utility Software. (REQUIRED for all CO-series except CO-100)
 - 1) Provide Handheld Programming Device for adaptable electronic access control products capable of the following minimum requirements.
 - a) Capable of initializing lock and accessories using preloaded software.
 - b) Utilized to field configure electronic access control devices, download firmware updates, collect audit files from access control device, and set date/time.

2.06 CYLINDERS

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product:
 - a. Schlage- Verify Keyway with Owner
- 2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Patented Restricted Small Format: cylinder with small format interchangeable cores (SFIC) with restricted, patented keyway.
3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.07 KEYING

A. Scheduled System:

1. Existing factory registered system:
 - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - a) 3 construction control keys
 - b) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - e. Quantity: Furnish in the following quantities.

- 1) Permanent Control Keys: 3.
- 2) Master Keys: 6.
- 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
- 4) Key Blanks: Quantity as determined in the keying meeting.

2.08 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.

2.09 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 1460 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.
2. Provide door closers with fully hydraulic, full rack and pinion action cast iron cylinder.
3. Closer Body: 1-1/4-inch (32 mm) diameter, with 5/8-inch (16 mm) diameter 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. Pressure Relief Valve (PRV) Technology: Not permitted.
8. 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.

2.10 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

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.

2.11 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
 - a. Glynn-Johnson
2. Acceptable Manufacturers:
 - a. Rixson

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.12 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

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.

2.13 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. 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.

2.14 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)

8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

- A. 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.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. 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
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. 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.
 3. Furnish permanent cores to Owner for installation.
- J. 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.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. 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.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. 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.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. 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.

3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 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:

Hardware Group No. 1

For use on Door #(s):

102 103 106 107 108 109
 110 111

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC		626	SCH
1	EA	SURFACE CLOSER	1461 FC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 2

For use on Door #(s):

104 105

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC		626	SCH
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	DOOR BOTTOM	364AA		AA	ZER








ADJUST DOOR UNDERCUT TO HAVE AUTO DOOR BOTTOM SEAL TO FLOORING.

Hardware Group No. 3

For use on Door #(s):

115A 115C

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	PANIC HARDWARE	98-L-06		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	FSIC CORE	23-030 VERIFY KWY GMK		626	SCH
1	EA	CLOSER W/STOP ARM	4111 SCUSH WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. 4

For use on Door #(s):
117A

Provide each RU door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
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EXISTING BAY DOOR ADD NEW MOTOR

Hardware Group No. 5

For use on Door #(s):
117B

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA CORRIDOR LOCK	ND73BD RHO K510-066	626	SCH
1	EA FINAL CORE	23-030 VFY KEYWAY GMKD	626	SCH
1	EA CLOSER W/STOP ARM	4111 SCUSH WMS	689	LCN
1	EA KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA WALL STOP	WS406/407CVX	630	IVE
1	EA GASKETING	488SBK PSA	BK	ZER
1	EA DOOR SWEEP	8198AA	AA	ZER
1	EA THRESHOLD	546A-223	A	ZER

Hardware Group No. 6

For use on Door #(s):
117C

Provide each SGL door(s) with the following:








QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA ELEC CLASSROOM LOCK	CO-200-CY-70-KP-RHO-J 4B BATTERY OPERATED	626	SCE
1	EA FSIC CORE	23-030 VERIFY KWY GMK	626	SCH
1	EA LOCK GUARD	LG10	630	IVE
1	EA CLOSER W/STOP ARM	4111 SCUSH WMS	689	LCN
1	EA KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA RAIN DRIP	142AA	AA	ZER
1	EA GASKETING	488SBK PSA	BK	ZER
1	EA DOOR SWEEP	8198AA	AA	ZER
1	EA THRESHOLD	103A-223 VERIFY SILL DETAIL	A	ZER

PATCH, PLUG AND REPAIR DOOR AND FRAME AS REQUIRED. REUSE HARDWARE LIKE HINGES, CLOSER AND THRESHOLD AS APPROPRIATE.

Hardware Group No. 7

For use on Door #(s):
118

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
2	EA	PUSH PLATE	8200 8" X 16"		630	IVE
2	EA	PULL PLATE	8302 8" 8" X 16"		630	IVE
2	EA	OH STOP	90S		630	GLY
2	EA	SURFACE CLOSER	1461 FC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

END OF SECTION

**SECTION 08 80 00
GLAZING**

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass products.
 - 2. Glazing sealants.
 - 3. Glazing tapes.
 - 4. Miscellaneous glazing materials.
- B. Related Requirements:
 - 1. Section 08 83 00 "Mirrors."
 - 2. Section 10 28 19 "Tub and Shower Enclosures" for shower door glazing.

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturers of fabricated glass units, glass testing agency and sealant testing agency.
- B. Product Certificates: For glass.
- C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

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GLAZING**

- B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain each glass product type from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective

**SECTION 08 80 00
GLAZING**

manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
 - 1. Design Wind Pressures: As indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - 2. Design Snow Loads: As indicated on Drawings.
 - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 - 4. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
 - 2. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 GLAZING SEALANTS

- A. General:

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GLAZING**

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 2. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
1. EPDM with Shore A durometer hardness per manufacturer's written instructions.
 2. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

**SECTION 08 80 00
GLAZING**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

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GLAZING**

- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

**SECTION 08 80 00
GLAZING**

3.8 MONOLITHIC GLASS SCHEDULE

- A. **GL-1:** Clear Glass Type: Annealed or Heat-strengthened float glass.
1. Minimum Thickness: 6 mm.
 2. Provide Fully Tempered safety glazing where required by code and/or where indicated on Drawings.

3.9 MIRROR SCHEDULE

- A. **GL-2:** Mirror Glass Type:
1. See Section 08 83 00 "Mirrors" for mirror glass.

END OF SECTION

**SECTION 08 83 00
MIRRORS**

SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silvered flat glass mirrors.
- B. Related Requirements:
 - 1. Section 08 80 00 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
 - 2. Section 10 28 00 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Mirrors: Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.
- C. Samples: For each type of the following:
 - 1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of mirror and mirror mastic.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors in accordance with mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

**SECTION 08 83 00
MIRRORS**

2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C1503; manufactured using copper-free, low-lead mirror coating process.
- B. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.
- C. Safety Glazing Products: For film-backed, laminated or tempered mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

2.4 FABRICATION

- A. Shop fabricate mirrors to greatest extent possible.
- B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat polished.
 - 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 - 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
 - 1. NGA Publications: "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass Mirrors."
- B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
 - 1. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

SECTION 08 83 00
MIRRORS

- c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

3.4 **CLEANING AND PROTECTION**

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

3.5 **MIRROR SCHEDULE**

- A. **GL-2:** Mirror Glass Type: Tempered Mirror Glass
 - 1. Minimum Nominal Thickness: 6 mm.
 - 2. Tint Color: None.

END OF SECTION

**SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING**

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grid suspension systems for gypsum board ceilings.
- B. Related Requirements:
 - 1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For items indicated to comply with requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design the following:
 - 1. Partition framing, openings, attachment and bracing including seismic restraint.
 - 2. Ceiling suspension systems, seismic restraints and attachment to supporting construction.
 - 3. Low partition reinforcement.
 - 4. Blocking for wall and ceiling supported items.
- B. Seismic Performance (by hierarchy): Suspended ceilings shall withstand the effects of earthquake motions determined according to the following:
 - 1. 2022 Oregon Structural Specialty Code (OSSC), 1613.1 and 1613.4.12.
 - 2. Northwest Wall and Ceiling Bureau (NWCB) "Field Technical Bulletin 401 – Revised 03/22."
 - 3. ASCE 7-16, Section 13 .5 .6.
 - 4. ASTM C635, ASTM C636 and ASTM E580.
 - 5. Ceilings and Interior Systems Construction (CISCA).
- C. Load Criteria:
 - 1. Vertical: 6 psf for single layer, 13 psf for double layer.
 - 2. Lateral: As indicated on the Structural Drawings.
 - 3. Occupancy Category, OSSC Table T1604.5: II.
 - 4. Duty Classification: Heavy, per ASTM C635.
 - 5. Cross Runner Deflection: L/360 maximum.
- D. Deflection:
 - 1. Horizontal
 - a. For composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft..

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NON-STRUCTURAL METAL FRAMING

- b. For non-composite wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft..
- c. For elevator shafts, limited to 1/240 of the wall height based on horizontal loading of 10 lbf/sq. ft..
- 2. Vertical: Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design standard roof loading with a maximum deflection of 1/2-inch unless otherwise indicated.
- 3. Ceiling Joist or Suspension Systems: Vertical deflection of 1/240 of the span.
- 4. Finishes and panel materials over framing shall not contribute to performance of partitions or suspension systems.

2.2 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58 or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - c. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Ceiling & Wall Solutions.
 - b. USG Corporation.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

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1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 24 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Do not attach hangers to steel roof deck.
 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
 2. Special inspections of the power actuated fasteners per State of Oregon, Statewide Code Interpretation, No. 10-1, dated October 2019.

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3. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- B. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

END OF SECTION

**SECTION 09 29 00
GYPSUM BOARD**

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
- B. Related Requirements:
 - 1. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
 - 2. Section 09 30 13 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For all products.
 - 1. Include installation instructions for acoustical products.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For acoustical putty pads, for tested performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.
- B. Gypsum Board, Type X: ASTM C1396/C1396M.

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1. Thickness: 5/8 inch.
2. Long Edges: Tapered.
- C. Moisture- and Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
 1. Core: 5/8 inch, Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 1. When fastening to cold-formed metal framing, use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber material requirements of assembly. Fiberglass is not permitted unless otherwise indicated in fire rated and tested assembly.
 2. Thickness: Match stud cavity depth.
- E. Acoustical Sealant: As specified in Section 07 92 19 "Acoustical Joint Sealants."
- F. Putty Pads: Nonhardening dielectric, water-resistant pads for installation around penetrations in acoustical-rated partitions.
 1. Non-Fire-Rated: Putty-pad for installation around penetrations in acoustical-rated partitions. Comply with ASTM C919 and ASTM E497 with product testing demonstrating equivalency of indicated partition assembly STC-rating.
 - a. Products: Subject to compliance with requirements, provide one of the following or equal.
 - 1) IsoBacker by Kinetics Noise Control.
 - 2) ATS Acoustics Putty Pads by ATS Acoustics.

**SECTION 09 29 00
GYPSUM BOARD**

- 3) QuietPutty by Pabco Gypsum.
- 2. Intumescent, Fire-Rated Assemblies: Comply with Division 07 "Firestopping" Sections.
 - a. Approved for use in UL or other code-accepted assembly listings.
- G. Drywall Clips: Preformed, metal drywall backer clips designed for use at inside corners with no stud backing or blocking.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840 and GA-216.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Where blocking and/or framing is not provided at inside corners, provide metal drywall clips for fastening gypsum board. Space clips not more than 16 inches o.c.
- F. Form control and expansion joints with space between edges of adjoining gypsum panels.
- G. Unless noted otherwise on the Drawings, cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- H. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Type X: At locations indicated on Drawings and where required for fire-resistance-rated assembly.
 - 3. Flexible Type: Apply in double layer at curved assemblies.

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4. Ceiling Type: Ceiling and other overhead surfaces unless otherwise indicated.
 5. Moisture- and Mold-Resistant Type: Wet or damp locations, and walls scheduled to receive tile.
 - a. Wet or damp locations are defined as walls with plumbing fixtures within four feet, walls, or ceilings susceptible to repeated moisture, restroom/bathroom walls and ceilings, commercial kitchen walls, shower rooms, locker rooms, mechanical rooms, trash rooms, and similar spaces.
- B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C840. Additional control joints indicated beyond that required by ASTM C840 are specific locations approved by Architect for visual effect.
 1. When control joints are not indicated on the Drawings, coordinate proposed locations with Architect prior to installation.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use at exposed panel edges and where indicated.
 3. L-Bead: Use where indicated.
 4. U-Bead: Use where indicated.
 5. Curved-Edge Cornerbead: Use at curved openings.

**SECTION 09 29 00
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3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. **Level 0:** Taping, finishing and cornerbeads are not required.
 - a. Locations: Locations indicated on Drawings.
 - 2. **Level 1:** Tape embed joints and interior angles in joint compound. Panel surfaces shall be free of excess joint compound. Tool marks and joint compound ridges are acceptable.
 - a. Locations: Ceiling plenum areas and other spaces permanently concealed from view.
 - 3. **Level 2:** Tape embed joints and interior angles in joint compound with one coat of joint compound applied over joints, angles, fastener heads and accessories. Panel surfaces shall be free of excess joint compound. Tool marks and joint compound ridges are acceptable.
 - a. Locations: Walls that are substrate for tile, ceilings that are substrate for acoustical tile and other locations indicated on Drawings.
 - 4. **Level 3:** Tape embed joints and interior angles in joint compound with one coat of joint compound applied over joints, angles, fastener heads and accessories. Apply one additional separate coat of joint compound over the taped joints, angles, fastener heads and accessories. Panel surfaces shall be free of excess joint compound. Finish joint compound smooth and free of tool marks and joint compound ridges.
 - a. Locations: Walls and ceilings scheduled to receive medium- or heavy-texturing and walls scheduled to receive other panelized finishes.
 - b. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 - 5. **Level 4:** Tape embed joints and interior angles in joint compound with one coat of joint compound applied over joints, angles, fastener heads and accessories. Apply two additional separate coats of joint compound over the taped joints. Apply one additional separate coat of joint compound over angles, fastener heads and accessories. Panel surfaces shall be free of excess joint compound. Finish joint compound smooth and free of tool marks and joint compound ridges.
 - a. Locations: At wall and ceiling surfaces that will be exposed to view (unless otherwise indicated) and walls or ceilings scheduled to receive light-texturing.
 - b. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

**SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES**

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic-rubber base.
- B. Related Requirements:
 - 1. Section 09 65 19 " Resilient Tile Flooring" for tile flooring.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.3 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE

- A. Product Standard: ASTM F1861, Type TP (rubber, PVC-free thermoplastic).
 - 1. Group: I (solid, homogeneous) or II (layered).
 - 2. Style: Style B, Cove.
- B. Thickness: 0.125 inch.
- C. Height: As indicated on Drawings.
- D. Lengths: Coils in manufacturer's standard length.
- E. Outside Corners: Job formed.
- F. Inside Corners: Job formed.
- G. Colors: As indicated on the Drawings.

**SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES**

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter corners to minimize open joints.

3.4 CLEANING AND PROTECTION

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

**SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES**

- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

**SECTION 09 65 19
RESILIENT TILE FLOORING**

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rubber floor tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full-size units of each color, texture, and pattern of floor tile required.
 - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
- C. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RUBBER FLOOR TILE

- A. Tile Standard: ASTM F1344.

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RESILIENT TILE FLOORING**

- B. Hardness: Manufacturer's standard hardness, measured using Shore, Type A durometer according to ASTM D2240.
- C. Thickness: As indicated on the Drawings.
- D. Size: As indicated on the Drawings.
- E. Manufacturer, Product, Patterns and Colors: As indicated on the Drawings.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Metal Edge/Transition Strips: Extruded aluminum with clear anodized finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

**SECTION 09 65 19
RESILIENT TILE FLOORING**

- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis in pattern indicated, unless noted otherwise on the Drawings.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

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

END OF SECTION

**SECTION 09 68 13
TILE CARPETING**

SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Modular carpet tile.
- B. Related Requirements:
 - 1. Section 09 65 13 "Resilient Base and Accessories" Section 09 65 19 "Resilient Tile Flooring" for resilient wall base and accessories installed with carpet tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Pattern type, location, and direction.
 - 3. Type, color, and location of edge, transition, and other accessory strips.
 - 4. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Sustainable Product Certification: If applicable, provide ANSI/NSF 140 certification for carpet products.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- B. Laboratory Test Reports: For carpet and carpet pad adhesives, indicating compliance with requirements for low-emitting materials.
- C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Carpet and Rug Institute's CRI 104.
- B. Deliver carpet in original mill protective packaging with mill register numbers and tags attached.

**SECTION 09 68 13
TILE CARPETING**

1.7 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Carpeting shall comply with the requirements of the DOC FF-1 "pill test" (CPS 16 CFR Part 1630) or with ASTM D2859.

2.2 CARPET TILE

- A. Manufacturer: As indicated on the Drawings.
- B. Product: As indicated on the Drawings.
- C. Color: As indicated on the Drawings.
- D. Backing/Backcoating: Manufacturer's standard composite materials, unless otherwise indicated on the Drawings.
- E. Size: As indicated on the Drawings.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
 - 1. Verify adhesive has a VOC content of 50 g/L or less.
- C. Self-Adhesive Dots or Strips: Manufacturer's proprietary self-adhesive dots or strips.
- D. Metal Edge/Transition Strips: Extruded aluminum with clear anodized finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

**SECTION 09 68 13
TILE CARPETING**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.

**SECTION 09 68 13
TILE CARPETING**

- B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

**SECTION 09 91 13
EXTERIOR PAINTING**

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Primed metal substrates.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.

1.2 DEFINITIONS

- A. MPI Gloss Level 1, "Flat": Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2, "Velvet": Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3, "Eggshell": 10 to 25 units at 60 degrees and minimum 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4, "Satin": 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5, "Semi-Gloss": 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6, "Gloss": 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7, "High-Gloss": More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 FIELD CONDITIONS

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

**SECTION 09 91 13
EXTERIOR PAINTING**

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace paint coatings that fail within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of coating beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Kelly-Moore Paint Company Inc.
 - 3. Miller Paint Company.
 - 4. Rodda Paint Co.
 - 5. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. VOC Content: For field applications, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 50 g/L.
 - 3. Primers, Sealers, and Undercoaters: 100 g/L.
 - 4. Rust-Preventive Coatings: 100 g/L.
 - 5. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 6. Pretreatment Wash Primers: 420 g/L.
- C. Colors: As indicated on the Drawings.

2.3 PRIMERS

- A. Quick Dry: Quick dry type for metal substrate.

2.4 PAINTS

- A. Light Industrial: Light industrial coating, exterior, water based.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

SECTION 09 91 13
EXTERIOR PAINTING

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.

3.4 CLEANING AND PROTECTION

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

3.5 EXTERIOR PAINTING SCHEDULE

- A. Steel and Iron Substrates:

**SECTION 09 91 13
EXTERIOR PAINTING**

1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based, velvet (MPI Gloss Level 2).

END OF SECTION

SECTION 09 91 23
INTERIOR PAINTING

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Steel and iron.
 - 2. Galvanized metal.
 - 3. Gypsum board.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.

1.2 DEFINITIONS

- A. MPI Gloss Level 1, "Flat": Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2, "Velvet": Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3, "Eggshell": 10 to 25 units at 60 degrees and minimum 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4, "Satin": 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5, "Semi-Gloss": 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6, "Gloss": 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7, "High-Gloss": More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Sustainable Design Submittals:
 - 1. Product Data: For paints and coatings, indicating VOC content.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

**SECTION 09 91 23
INTERIOR PAINTING**

1.6 FIELD CONDITIONS

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

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace paint coatings that fail within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Kelly-Moore Paint Company Inc.
 - 3. Miller Paint Company.
 - 4. Rodda Paint Co.
 - 5. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. VOC Content: For field applications, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings (walls and ceilings): 50 g/L.
 - 2. Nonflat Paints and Coatings (walls and ceilings): 50 g/L.
 - 3. Trim Paints: 150 g/L.
 - 4. Primers, Sealers, and Undercoaters: 50 g/L.
 - 5. Rust-Preventive Coatings: 100 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
- C. Colors: As indicated on the Drawings.

2.3 PRIMERS

- A. Latex: Latex, interior.
- B. Quick Dry: Quick dry type for metal substrate.

2.4 PAINTS

- A. Latex: Latex, interior.
- B. Light Industrial: Light industrial coating, interior, water based.
- C. Epoxy: 2-part epoxy, interior.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

SECTION 09 91 23
INTERIOR PAINTING

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 11.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.

**SECTION 09 91 23
INTERIOR PAINTING**

- b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint the following work where exposed in occupied spaces:
- a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

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

3.5 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 - 1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based.
- B. Galvanized-Metal Substrates:
 - 1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based.
- C. Gypsum Board Substrates, Typical Walls and Ceilings:
 - 1. Latex over Latex Sealer System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior.
- D. Gypsum Board Substrates, Wet Locations:
 - 1. Epoxy over Latex Sealer System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Intermediate Coat: Epoxy, interior, matching topcoat.
 - c. Topcoat: Epoxy, interior.

END OF SECTION

**SECTION 10 14 23.16
ROOM-IDENTIFICATION PANEL SIGNAGE**

SECTION 10 14 23.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample.
- D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Plaques: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

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ROOM-IDENTIFICATION PANEL SIGNAGE

1. Laminated-Sheet Sign Material: Photopolymer or sandblasted polymer face sheet with raised graphics, text and/or Braille laminated to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: 0.125 inch.
 - b. Surface-Applied Graphics: Applied paint or photo image. Raised minimum 1/32-inch.
 - c. Color(s): Black.
2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
3. Mounting: Surface mounted to wall with adhesive or two-face tape.
4. Typeface: Raised characters in Sans Serif typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color. Characters shall be 5/8-inch tall, unless noted otherwise.
5. Braille: Provide raised Braille where indicated. Finish Braille to match background color.
6. Size(s): 6-inch wide by 8-inch high, unless otherwise indicated or as required to fit graphics and characters.
7. Signage Items:
 - a. Room-Identification Signs:
 - 1) Qty. / Text:
 - a) Qty. (2), <"RESTROOM">, with ADA symbol and Braille.

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - b. Fastener Heads: Use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head, spanner-head, or one-way-head slots unless otherwise indicated.
 3. Sign Mounting Fasteners:
 - a. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

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ROOM-IDENTIFICATION PANEL SIGNAGE

4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
 1. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 3. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

**SECTION 10 26 00
WALL AND DOOR PROTECTION**

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall coverings.
- B. Related Requirements:
 - 1. Section 08 71 00 "Door Hardware" for metal and plastic protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
 - 1. Include plans, elevations, sections, and attachment details.[Show handrail design and support spacing required to withstand structural loads.]
- C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.
 - 1. Include Samples of accent strips and accessories to verify color selection.
- D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
 - 1. Wall Covering: 6 by 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of exposed plastic material.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.

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WALL AND DOOR PROTECTION**

- b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
- 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in and ICC A117.1.

2.3 WALL COVERINGS

- A. FRP Sheet Wall Covering: Fabricated from fiberglass reinforced plastic sheet wall-covering material.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Marlite.
 - 2. Size: 48 by 96 inches for sheet or 48 by 120 inches for roll.
 - 3. Sheet Thickness: 3/32-inch.
 - 4. Fire Rating: Class C.
 - 5. Texture: Smooth.
 - 6. Color: As indicated on the Drawings.
 - 7. Height: As indicated on the Drawings.
 - 8. Trim and Joint Moldings: Extruded aluminum with matching powder coated finish and white PVC trim and joint moldings. See Drawings for locations of both materials.
 - 9. Mounting: Adhesive.

2.4 MATERIALS

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.
 - 1. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 200 or less.
 - b. Smoke-Developed Index: 450 or less.
- B. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- D. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

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WALL AND DOOR PROTECTION**

- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
 - 3. Adjust end and top caps as required to ensure tight seams.
- D. Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Private-use bathroom accessories.
 - 2. Underlavatory guards.
- B. Related Requirements:
 - 1. Section 08 83 00 "Mirrors" for frameless mirrors.

1.2 COORDINATION

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

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

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRIVATE-USE BATHROOM ACCESSORIES

- A. Manufacturers: As indicated in the Schedule of Accessories.
- B. Accessories include but are not limited to the following:
 - 1. Toilet tissue dispensers.
 - 2. Grab bars.
 - 3. Paper towel dispenser.
 - 4. Sanitary napkin disposal.
 - 5. Sanitary seat cover dispenser.
 - 6. Soap dispensers.

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

- 7. Mirrors.
- 8. Hooks.
- C. Schedule of Accessory Items: See Drawings for schedule of items.

2.2 UNDERLAVATORY GUARDS

- A. Underlavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

2.3 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.4 FABRICATION

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which accessories will be attached for blocking and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

3.3 ADJUSTING AND CLEANING

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

END OF SECTION

**SECTION 10 28 19
TUB AND SHOWER ENCLOSURES**

SECTION 10 28 19 - TUB AND SHOWER ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Semi-Frameless shower doors and enclosures.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for shower doors and enclosures.
- B. Shop Drawings: For tub and shower doors and enclosures.
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For tub and shower doors and enclosures.
 - 1. Each type of mounting and operating hardware; full size.
 - 2. Glass and glazing; 12 inches square.
 - 3. Trim; 12-inch lengths.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For tub and shower doors and enclosures to include in maintenance manuals.

1.6 FIELD CONDITIONS

- A. Verify dimensions by field measurements before fabrication and indicate on Shop Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tub and shower doors and enclosures that fail in materials or workmanship within specified warranty period, without monetary limitation.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period: One years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SEMI-FRAMED ENCLOSURES

- A. Glass panels with full perimeter frames of extruded aluminum with screw-fastened corners. Minimum 3/8-inch penetration of glass into frame. Framing members of thickness required to support imposed loads.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Basco, Inc. or equal.
- B. Frames, Hardware, and Trim: Manufacturer's standard units as indicated and as required for a complete installation.
 - 1. Materials: Aluminum; ASTM B221.

SECTION 10 28 19
TUB AND SHOWER ENCLOSURES

- 2. Finish: To be selected by the Architect from the manufacturer's full range of options.
- C. Bypassing Doors: Sliding units suspended from top track by fully adjustable ball-bearing rollers. Self-draining sill tracks with nylon panel guides. Molded jamb bumpers with concealed fasteners.
 - 1. Door Pulls: Full-door-width, single-sided towel bars.
- D. Glazing: Safety glazing materials complying with 16 CFR 1201, Category II, with permanently etched identification acceptable to authorities having jurisdiction.
 - 1. Glass Nominal Thickness: 10 mm.
 - 2. Clear Glass: ASTM C1048, Type I, Quality-Q3, Class I (clear), Kind FT.
 - 3. Protective, Self-Cleaning, Glass Coating: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
- E. Fasteners: Manufacturer's standard stainless steel or other noncorrosive fasteners.
- F. Sealant: Mildew-resistant, single-component, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, for Use NT.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare and install per manufacturer's written instructions unless more stringent requirements are contained in GANA's "Glazing Manual."
- B. Clean substrates, removing projections, filling voids, and sealing joints.
- C. Set units level, plumb, and true to line, without warp or rack of frames and panels, and anchor securely in place.
- D. Fasten components securely in place, with provisions for thermal movement. Install with concealed fasteners unless otherwise indicated.
- E. Install components to drain and return water to tub or shower.
- F. Install doors to produce smooth operation and tight fit at contact points.
- G. Repair, refinish, or replace components damaged during installation.

3.2 ADJUSTING AND CLEANING

- A. Adjust operating parts and hardware for smooth, quiet operation and watertight closure. Lubricate hardware and moving parts.
- B. Remove nonpermanent labels, and clean surfaces immediately after installation.

3.3 TUB AND SHOWER DOOR AND ENCLOSURE HARDWARE

- A. Provide manufacturer's standard hardware including door pulls, rollers, carrier system, and towel bar. Finish to be selected by the Architect from the manufacturer's full range of options.

END OF SECTION

**SECTION 12 36 61.16
SOLID SURFACING COUNTERTOPS**

SECTION 12 36 61.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
- B. Related Requirements:
 - 1. Division 22 "Plumbing" for non-integral sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops.
 - 1. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 2. Include plans, sections, details, and attachments to other work.
 - 3. Show locations and details of joints.
 - 4. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1. Provide Standard type unless Special Purpose type is indicated.
 - 1. Manufacturer: As indicated on the Drawings.
 - 2. Colors and Patterns: As indicated on the Drawings.
 - 3. Countertops Thickness: 12- millimeter (1/2-inch) thick.
 - 4. Backsplash Thickness: 12- millimeter (1/2-inch) thick.

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- 5. Recycled Content: Postconsumer recycled content shall be not be less than 25 percent.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Countertop Edges: 1-1/2-inch laminated, straight cut, slightly eased at top
 - 2. Backsplash Edges: Straight, slightly eased at corner.
- C. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- D. Joints: Fabricate countertops without joints to the greatest extent possible. When joints are unavoidable, fabricate countertops in sections for joining in field.
 - 1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
- E. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
 - 4. Counter-Mounted Appliances: Prepare countertops in shop for field cutting openings for appliances. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

2.4 ACCESSORIES

- A. Countertop Support Brackets: Prefabricated steel countertop support brackets.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A&M Hardware, Inc.
 - 2. Type: Concealed bracket with countertop support arm; 2-inch steel angle construction.
 - 3. Size: 9-inch, 12-inch, 15-inch, 18-inch, 21-inch, 24-inch or 30-inch as required for support of countertop depth.
 - 4. Finish: Painted, white.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 **INSTALLATION**

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- I. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION

**SECTION 13 34 19
METAL BUILDING SYSTEMS**

SECTION 13 34 19 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural-steel framing.
 - 2. Metal roof panels.
 - 3. Metal wall panels.
 - 4. Thermal insulation.
 - 5. Personnel doors and frames.
 - 6. Accessories.
- B. Related Requirements:
 - 1. Section 08 36 13 "Sectional Doors" for sectional vehicular doors in metal building systems.

1.2 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.
 - 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.
 - 3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.

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- c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
- d. Temporary protection requirements for metal wall panel assembly during and after installation.
- e. Wall observation and repair after metal wall panel installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Metal roof panels.
 - b. Metal wall panels.
 - c. Thermal insulation and vapor-retarder facings.
 - d. Personnel doors and frames.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
 - 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
 - 2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 - 3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
 - b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
 - c. Show translucent panels.
 - 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 - d. Service walkways.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For the following products:
 - 1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 - 2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
 - 3. Vapor-Retarder Facings: Nominal 6-inch-square Samples.
 - 4. Accessories: Nominal 12-inch-long Samples for each type of accessory.
- E. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
 - 1. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
- F. Delegated-Design Submittal: For metal building systems.
 - 1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For erector and manufacturer.

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- B. Welding certificates.
- C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Name and location of Project.
 - 2. Order number.
 - 3. Name of manufacturer.
 - 4. Name of Contractor.
 - 5. Building dimensions including width, length, height, and roof slope.
 - 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - 7. Governing building code and year of edition.
 - 8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 - 9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - 10. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- D. Erector Certificates: For qualified erector, from manufacturer.
- E. Material Test Reports: For each of the following products:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
 - 5. Nonshrink grout.
- F. Source quality-control reports.
- G. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
 - 1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
 - 2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.
- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

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1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- E. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.
- F. Bay Spacing: As indicated on Drawings.
- G. Roof Slope: 1 inch per 12 inches.
- H. Roof System: Manufacturer's standard to match existing adjacent metal building roof panels.
1. Liner Panels: Match existing adjacent metal building system.
- I. Exterior Wall System: Manufacturer's standard to match existing adjacent metal building wall panels.
1. Liner Panels: Match existing adjacent metal building system.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
1. Design Loads: As indicated on Drawings.
 2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
 3. Deflection and Drift Limits: No greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/240 of the span.

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- b. Girts: Horizontal deflection of 1/180 of the span.
 - c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
 - d. Metal Wall Panels: Horizontal deflection of 1/180 of the span.
 - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - f. Lateral Drift: Maximum of 1/100 of the building height.
- C. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Fire Propagation Characteristics: Exterior wall assemblies containing foam plastics pass NFPA 285 fire test.
- F. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
- 1. Wind Loads: As indicated on Drawings.
- G. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:
- 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- H. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
- 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- I. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:
- 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- J. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
- 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- K. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated on the Structural Drawings.
- L. Energy Star Listing: Roof panels that are listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for steep-slope roof products.
- M. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:
- 1. Three-year, aged, solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
 - 2. Three-year, aged, Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.
- N. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C1363 or ASTM C518:
- 1. Roof:
 - a. U-Factor: 0.037.
 - b. R-Value: R-19 + R-11.
 - 2. Walls:
 - a. R-Value: R-25.

2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

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- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 3. Frame Configuration: Single gable.
 4. Exterior Column: Tapered.
 5. Rafter: Tapered.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.
 - a. Depth: As needed to comply with system performance requirements.
 2. Purlins: Steel joists of depths indicated on Drawings.
 3. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch-wide flanges.
 - a. Depth: As required to comply with system performance requirements.
 4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 5. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch-diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 6. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 7. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
 8. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 9. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- G. Bracing: Provide adjustable wind bracing using any method as follows:
1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Cable: ASTM A475, minimum 1/4-inch-diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
 3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 4. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

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5. Pinned-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 6. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
- H. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- I. Materials:
1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
 5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
 6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
 7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
 8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.
 9. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for primary framing.
 10. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for secondary framing.
 11. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
 - a. Finish: Plain.
 12. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - a. Finish: Plain.
 13. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 14. Unheaded Anchor Rods: ASTM F1554, Grade 36.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A36/A36M carbon steel.
 - d. Washers: ASTM F436 hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
 15. Headed Anchor Rods: ASTM F1554, Grade 36.
 - a. Configuration: Straight.

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- b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A36/A36M carbon steel.
 - d. Washers: ASTM F436 hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
16. Threaded Rods: ASTM A36/A36M.
- a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Washers: ASTM A36/A36M carbon steel.
 - c. Finish: Hot-dip zinc coating, ASTM F2329, Class C.
- J. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
- 1. Clean and prepare in accordance with SSPC-SP2.
 - 2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

- A. Standing-Seam, Vertical-Rib, Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
- 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Exterior Finish: Two-coat fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Clips: Two-piece floating to accommodate thermal movement.
 - 3. Joint Type: Mechanically seamed.
 - 4. Panel Coverage: 16 inches.
 - 5. Panel Height: 2 inches.
- B. Finishes:
- 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.6 METAL WALL PANELS

- A. Exposed-Fastener, Tapered, Reverse-Rib, Metal Wall Panels (Match Existing Metal Building Wall Panel Type): Formed with recessed, trapezoidal major valleys and intermediate stiffening valleys symmetrically spaced between major valleys; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
- 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 - 2. Major-Rib Spacing: Match existing metal panel spacing.
 - 3. Panel Coverage: Match existing metal panel coverage.
 - 4. Panel Height: Match existing metal panel height.
- B. Finishes:
- 1. Exposed Coil-Coated Finish:

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- a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.7 THERMAL INSULATION

- A. Faced Metal Building Insulation: ASTM C991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- B. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- C. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96/E96M, Desiccant Method.
 1. Composition: White polypropylene film facing and fiberglass-polyester-blend fabric backing.
- D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.8 PERSONNEL DOORS AND FRAMES

- A. Swinging Personnel Doors and Frames: As specified in Section 08 11 13 "Hollow Metal Doors and Frames."

2.9 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

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3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
 1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
 1. Gutter Supports: Fabricated from same material and finish as gutters.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.
 1. Mounting Straps: Fabricated from same material and finish as gutters.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- H. Materials:
 1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
 - b. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels.
 - c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
 4. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.10 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.

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1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 1. Make shop connections by welding or by using high-strength bolts.
 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 1. Make shop connections by welding or by using non-high-strength bolts.
 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.11 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
 1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
 - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.
 - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Steel Joists: Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Joist Installation: Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
 - 5. Joist Installation: Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.

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- 6. Joist Installation: Weld joist seats to supporting steel framework.
- 7. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
- I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 - 1. Tighten rod and cable bracing to avoid sag.
 - 2. Locate interior end-bay bracing only where indicated.
- J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 - 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 - 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
 - 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Locate metal panel splices over structural supports with end laps in alignment.
 - 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
 - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
 - 1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

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3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
 - 1. Install ridge caps as metal roof panel work proceeds.
 - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
 - 1. Install clips to supports with self-drilling or self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Pre-drill panels for fasteners.
 - 5. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge caps.
- C. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 - 2. Shim or otherwise plumb substrates receiving metal wall panels.
 - 3. When two rows of metal panels are required, lap panels 4 inches minimum.
 - 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 - 5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Pre-drill panels.
 - 6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 7. Install screw fasteners in pre-drilled holes.
 - 8. Install flashing and trim as metal wall panel work proceeds.
 - 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
 - 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 - 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
- C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
 - 1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.

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2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
3. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
 1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
 2. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
 3. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 4. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 5. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
 1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
 2. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.

3.8 DOOR AND FRAME INSTALLATION

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
 1. Between Doors and Frames at Jamb and Head: 1/8 inch.
 2. Between Edges of Pairs of Doors: 1/8 inch.
 3. At Door Sills with Threshold: 3/8 inch.
 4. At Door Sills without Threshold: 3/4 inch.
- C. Door Hardware:
 1. Install surface-mounted items after finishes have been completed at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 4. Set thresholds for exterior doors in full bed of sealant complying with requirements for concealed mastics specified in Section 07 92 00 "Joint Sealants."

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3.9 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Tie downspouts to underground drainage system indicated.

3.10 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.

3.12 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

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- C. Touchup Painting: Cleaning and touchup painting are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- D. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- E. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
 - 1. Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

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PART 1 - GENERAL

1.1 DESIGN-BUILD SUMMARY

- A. Work included in 22 00 00 applies to Division 22, Plumbing work to provide materials, labor, tools, permits and incidentals to make plumbing systems ready for Owner's use for proposed Project.

1.2 DESIGN-BUILD INSTRUCTIONS

- A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete plumbing system for this Project.
- B. Alternates to this Document may be offered as a separate proposal.
- C. Bidder to submit the following information with the Proposal:
 - 1. Preliminary drawings indicating major equipment locations and preliminary layout.
 - 2. Description of systems, manufacturer and method of control.
 - 3. List of materials proposed for systems which are applicable to this Project.
 - 4. Any other information which the bidder considers pertinent in evaluating the proposal.

1.3 DESIGN-BUILD APPROACH

- A. Use this Specification for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of Project.
- B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by Authority Having Jurisdiction (AHJ).
- C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.4 DESIGN-BUILD CRITERIA/CALCULATIONS

- A. Related Work Specified Elsewhere: Contents of Section apply to Division 22 Specifications. Requirements of Section are a minimum for Division 22 Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.
- B. Design Criteria: Reference Basis of Design narrative document.
- C. Design Criteria:
 - 1. Size waste, condensate drainage, water and vent piping in accordance with State Plumbing code and local jurisdiction requirements.
 - 2. Size domestic water piping with a maximum pressure drop of 2 PSI per 100 feet and a maximum velocity of 6 feet per second for hot and cold water. For hot water return calculate maximum velocity no greater than 4 ft/second. Service to be 3/4-inches minimum. Provide larger service if required per UPC fixture unit calculation. Piping mains inside building to be above ceiling.
 - 3. Provide rough-in and connections for waste, condensate drainage, water and vents to all new plumbing fixtures. Coordinate location of rough-in with Architect and Mechanical.
 - 4. Provide pressure-reducing station on incoming water supply, where service pressure exceeds 80 PSI static.
 - 5. Add Floor drains in new locker rooms as required per code.
 - 6. Provide floor drain in front of the washer box and provide trap primer.
 - 7. Provide cold water supply to refrigerator at Classroom with sov.
 - 8. Provide cold water supply for coffee maker at Classroom with sov.
 - 9. Provide plumbing fixture as indicated on Architectural drawings.

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10. Provide new water heater to serve new Locker Room restrooms, coordinate with architects drawings.
 11. Replace existing water heater with new.
 12. Provide trap primer assembly and connect to the nearest cold water larger then a 3/4-inch.
- D. Calculations:
1. Submit the following Plumbing Calculations:
 - a. Water Sizing Calculations.
 - b. Storm Drainage Calculations.
 - c. Structural Calculations for Seismic Bracing of Plumbing Equipment and Piping.
 - d. Hot Water Heater Calculations.
 2. Structural calculations to be signed by a registered Engineer in the State of Oregon.

1.5 SECTION INCLUDES

- A. Work included in 22 00 00, Plumbing Basic Requirements applies to Division 22, Plumbing work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of plumbing systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 1. Provide: To furnish and install, complete and ready for intended use.
 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.6 RELATED SECTIONS

- A. Contents of Section applies to Division 22, Plumbing Contract Documents.
- B. Related Work:
 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits
 2. Section 23 11 23, Facility Fuel - Natural Gas Piping and Systems

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1.7 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, individual Division 22, Plumbing Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 - 1. State of Oregon:
 - a. OAR - Oregon Administrative Rules
 - b. 2023 OESC - Oregon Electrical Specialty Code
 - c. 2022 OFC - Oregon Fire Code
 - d. 2022 OMSC - Oregon Mechanical Specialty Code
 - e. 2023 OPSC - Oregon Plumbing Specialty Code
 - f. 2022 OSSC - Oregon Structural Specialty Code
 - g. 2021 OEESC - Oregon Energy Efficiency Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 - 1. ABA - Architectural Barriers Act
 - 2. ADA - Americans with Disabilities Act
 - 3. AHRI - Air-Conditioning Heating & Refrigeration Institute
 - 4. ANSI - American National Standards Institute
 - 5. ASCE - American Society of Civil Engineers
 - 6. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
 - 7. ASHRAE Guideline 0, the Commissioning Process
 - 8. ASME - American Society of Mechanical Engineers
 - 9. ASPE - American Society of Plumbing Engineers
 - 10. ASSE - American Society of Sanitary Engineering
 - 11. ASTM - ASTM International
 - 12. AWWA - American Water Works Association
 - 13. CFR - Code of Federal Regulations
 - 14. CGA - Compressed Gas Association
 - 15. CISPI - Cast Iron Soil Pipe Institute
 - 16. ETL - Electrical Testing Laboratories
 - 17. EPA - Environmental Protection Agency
 - 18. FM - FM Global
 - 19. IAPMO - International Association of Plumbing and Mechanical Officials
 - 20. GAMA - Gas Appliance Manufacturers Association
 - 21. HI - Hydraulic Institute Standards
 - 22. ISO - International Organization for Standardization
 - 23. MSS - Manufacturers Standardization Society
 - 24. NEC - National Electric Code
 - 25. NEMA - National Electrical Manufacturers Association
 - 26. NFGC - National Fuel Gas Code
 - 27. NFPA - National Fire Protection Association
 - 28. NRCA - National Roofing Contractors Association
 - 29. NSF - National Sanitation Foundation
 - 30. OSHA - Occupational Safety and Health Administration
 - 31. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
 - 32. TEMA - Tubular Exchanger Manufacturers Association
 - 33. TIMA - Thermal Insulation Manufacturers Association
 - 34. UL - Underwriters Laboratories Inc.
- D. See Division 22, Plumbing individual Sections for additional references.

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1.8 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 22, Plumbing Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 - 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 - 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail or posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
 - 3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 22, Plumbing Sections.
 - 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents and schedules. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference Division 22, Plumbing Sections for specific items required in product data submittal outside of these requirements.
 - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - d. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
 - e. See Division 22, Plumbing Sections for additional submittal requirements outside of these requirements.
 - 5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to Contractor without review.
 - 6. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-16 requirements for non-structural components. Provide engineered seismic

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- drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
7. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 22, Plumbing Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
 8. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
 9. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any product marked "or approved equivalent," a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
 10. Shop Drawings: Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout plans, and control wiring diagrams. Reference individual Division 22, Plumbing Sections for additional requirements for Shop Drawings outside of these requirements.
 - a. Provide Shop Drawings indicating sanitary and storm cleanout locations and type to Architect for approval prior to installation.
 - b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
 11. Samples: Provide samples when requested by individual Sections.
 12. Resubmission Requirements:
 - a. Make corrections or changes in submittals as required in response to Engineer's comments. Provide a cover letter with resubmittal that includes responses to each of the Engineer's submittal review comments and identifies changes in the resubmittal. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates "no exception taken" or "make corrections noted."
 - 2) When submitting drawings for Engineer's re-review, clearly indicate changes on drawings and cloud any revisions. Submit a list describing each change.
 13. Operation and Maintenance Manuals, Owner's Instructions:
 - a. Submit, at one time, electronic files (native/searchable PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.

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- 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 4) Include copy of startup and test reports specific to each piece of equipment.
 - 5) Include copy of final water systems balancing log along with pump operating data.
 - 6) Include commissioning reports.
 - 7) Include copy of pressure, flow, leakage and purity test data and air and water systems test data, as applicable. Include copy of third-party and state and local jurisdiction inspection reports.
 - 8) Include copy of valve charts/schedules.
 - 9) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
 - 10) Include product certificates of warranties and guarantees.
 - 11) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
- b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 22 00 00, Plumbing Basic Requirements article titled "Demonstration."
- c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
14. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for Project.
 - c. At completion of project, input changes to original project on Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit Model and drawings upon substantial completion.

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- d. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.
- e. Provide Invert elevations and dimensioned locations for water services, building waste, and storm drainage piping below grade extending to 5-feet outside building line.
- f. See Division 22, Plumbing individual Sections for additional items to include in record drawings.

1.9 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturers equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. All potable water system components, devices, material, or equipment containing a weighted average of greater than 0.25 percent lead are prohibited, and shall be certified in accordance with current editions of the Safe Drinking Water Act (SDWA), NSF 61 & NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61.
- I. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- J. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.10 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty in Division 01, General Requirements and the General Conditions.

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Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in the event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.12 WORK INCLUDED

- A. Furnish and install sleeves, inserts and anchorage required for the installation, which are embedded in work of other trades. Sleeve, wrap and seal piping in concrete.
- B. Electrical: For plumbing trim/devices/equipment, provide, from the line voltage connection by Division 26, the low voltage electrical connections and wiring as required for complete and operable system. Includes, but is not limited to: Low voltage electrical raceway, wiring and accessories, such as step-down transformers as necessary for function of sensors and automatic valve and faucet controls. Supply step-down transformers and size wiring as recommended by manufacturer of plumbing trim/faucets requiring electrical low voltage connection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to fixtures, pumps, drains and equipment.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

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2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 22, Plumbing Sections. In the absence of specific requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Milcor, Elmdor, Acudor, or approved equivalent.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment requiring access (i.e., drain pans, drains, control operators, valves, motors, cleanouts and water heaters) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions of related earthwork Sections/divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

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- E. Firestopping:
 - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
 - 1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
 - 2. Include provisions for servicing and removal of equipment without dismantling piping.
- G. Plenums:
 - 1. Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 22 Plumbing Sections.
- B. General:
 - 1. Earthquake resistant designs for Plumbing (Division 22) equipment and distribution, i.e. motors, plumbing systems, piping, equipment, water heaters, boilers, etc. to conform to regulations of jurisdiction having authority.
 - 2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
 - 3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
 - 4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
- C. Piping:
 - 1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
- D. Provide means to prohibit excessive motion of plumbing equipment during earthquake.

3.3 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.

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- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground piping installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.
- D. Final Punch:
 - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Plumbing Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the plumbing systems are ready for final punch.
 - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping, and wiring to point of connection.
 - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 - 4. Organize work to minimize duration of power interruption.

3.5 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 - 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftspeople of each respective trade in conformance with appropriate Division of Work.
 - 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

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4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing piping and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.
- 3.6 **EQUIPMENT SELECTION AND SERVICEABILITY**
- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.
- 3.7 **DELIVERY, STORAGE AND HANDLING**
- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar items until in service.
- 3.8 **DEMONSTRATION**
- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
 - B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
 - C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.
- 3.9 **CLEANING**
- A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
 - B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.
- 3.10 **INSTALLATION**
- A. Confirm installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic

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Requirements and individual Division 22, Plumbing Sections.

- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 - 1. Do not place equipment in sustained operation prior to initial balancing of plumbing systems.
 - 2. Provide pump impellers to obtain Basis of Design design capacities.
- D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.11 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. Ferrous Metal: After completion of plumbing work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 - 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements in Division 01, General Requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. Coordinate locations/sizes of access panels with Architect prior to work. Label access panels with engraved nameplates indicating function of panel.

3.13 DEMOLITION

- A. Confirm Demolition requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
 - 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to plumbing system required to meet code, and accommodate installation of new work.
 - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.

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2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
3. Unless specifically indicated on Drawings, remove exposed, unused piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap piping and patch surfaces to match surrounding finish.
4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing and Balancing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document and Commissioning Reports

3.15 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Tests:
 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.16 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that plumbing items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.17 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize plumbing equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

END OF SECTION

SECTION 22 05 13
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Motor Construction and Requirements
 - 2. Starters
 - 3. Variable Frequency Drives
 - 4. Disconnects

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NEMA Premium Efficiency.
 - 2. Energy Policy Act (EPACT), latest applicable version(s) for minimum motor efficiencies.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.
- B. In addition, meet the following:
 - 1. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.
 - 2. Electrical components and materials to be UL and ETL listed/labeled as suitable for location and use.
 - 3. Variable Frequency Drives: Materials and installation for a complete adjustable frequency motor drive consisting of a pulse width modulated (PWM) inverter for use on a standard NEMA Design B induction motor. Design drive specifically for variable torque applications. Variable Frequency Drive (VFD) provided by Controls Section or equipment manufacturer.
 - a. A firm engaged in the production of this type of equipment for a minimum of 10 years.
 - b. Testing: Test printed circuit boards and burned in before being assembled into the completed VFD. Subject VFD to a preliminary functional test, minimum 8-hour burn-in, and computerized final test at 104 degrees F at full rated load.
 - c. Qualifications:
 - 1) UL Listed.
 - 2) C-UL listed or CSA approved.
 - 3) Warranty: 12 months from the date of certified start-up. Include parts, labor, travel time, and expenses.

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COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. For motors 50 HP and Larger: Provide five year manufacturer's limited warranty from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Motors (General):
 - 1. Lincoln Motors
 - 2. Century Electric Motors (formerly A.O. Smith Electrical Products)
 - 3. Baldor Electric (Reliance Electric)
 - 4. General Electric
 - 5. Toshiba
 - 6. Or approved equivalent.
 - 7. Exceptions: Motors integral to equipment efficiency listing (EER, COP, etc.) per listing agency.
- B. Starters:
 - 1. Cerus
 - 2. Eaton Electrical
 - 3. General Electric
 - 4. Siemens
 - 5. Schneider Electric/Square D
 - 6. Or approved equivalent.
- C. Variable Frequency Drives:
 - 1. ABB
 - 2. Allen Bradley
 - 3. Cerus
 - 4. Danfoss
 - 5. Emerson
 - 6. General Electric
 - 7. Siemens
 - 8. Schneider Electric/Square D
 - 9. Toshiba
 - 10. Trane
 - 11. Yaskawa
 - 12. Or approved equivalent.
- D. Disconnects:
 - 1. Provided and installed by Division 26, Section 26 28 16, Enclosed Switches and Circuit Breakers. See this section for manufacturer information.

2.2 GENERAL MOTOR CONSTRUCTION AND REQUIREMENTS

- A. Electrical components and materials to be UL to ETL listed/labeled as suitable for location and use.
- B. Wiring installed in conduit.
- C. Electrical Service: Power wiring from source to motor termination under Division 26, Electrical. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.
- D. Electrical Service - Unless otherwise noted in the Contract Documents, the following voltage and phase characteristics apply to motors:
 - 1. Motors 1/2 HP and Under: 120 volt, 1 phase.

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2. Motors 3/4 HP and Over: 208 volt, 3 phase.
3. Motors 3/4 HP and Over: 480 volt, 3 phase
- E. 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 1 limits for insulation class, service factor, and motor enclosure type.
 4. Built-in thermal overload protection or externally protected with separate overload with low-voltage release or lock-out. Quick trip device on hermetically sealed motors.
 5. Service Factor: 1.15 for poly-phase motors. 1.25 for motors associated with shaft pressurization system fans. 1.35 for single phase motors.
 6. Noise Rating: Quiet.
 7. Efficiency: Provide premium efficiency motors.
 8. Motors used in Conjunction with Variable Speed Drives: Variable torque type matched for the full operating range of the variable frequency drive. As a minimum, motors to have Class F insulation, winding insulation rated for 1000 volts and insulated bearings to prevent high frequency ground path. Loads not-to-exceed 80 percent of nameplate rating.
- F. Explosion-Proof Motors: UL approved and labelled for hazard classification with over temperature protection.
- G. 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.
- H. Wiring Terminations:
 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Coordinate conductor sizes with Division 26, Electrical. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- I. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.
- J. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency and latest EPACT.
- K. Vertical in-line pump motors per NEMA MG1, Motors and Generators.

2.3 STARTERS

- A. Single-Phase Motors:
 1. Manual across-the-line starting switch having toggle-operated switch pilot running light and built-in thermal overload device with heating element rated not more than 115 percent motor full load current indicated on name plate of motor to be protected. Surface mount starters. Provide NEMA-1 enclosure.
 2. Overload relays to be melting alloy type with a replaceable control circuit module. Thermal units to be interchangeable. Starter to be nonoperative if thermal unit is removed.
 3. Single-phase motors with automatic controls. Provide motor-rated relay with coils rated for control voltage.
- B. Starters up to Size 8 to be suitable for the addition of a minimum of three external auxiliary contacts (normally open or normally closed). Contactor, coils and relays to perform the control functions of the associated equipment and control sequence.
- C. 3-Phase Motors up to and Including 15 HP:

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1. Provide enclosed type magnetic across-the-line starter with thermal overload and undervoltage protection.
2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.
3. Starters for 3-phase motors to have overload protection in each of the three legs, with external manual reset.

2.4 VARIABLE FREQUENCY DRIVES

- A. Design: Solid state, with a Pulse Width Modulated (PWM) output waveform enclosed in a NEMA 1 enclosure, completely assembled and tested by manufacturer. Employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device drive efficiency: 97 percent or better at full speed and full load. Fundamental Power Factor: 0.98 at all speeds and loads. Unit designed to feed two motors simultaneously.
- B. Specifications:
 1. Input 440/450/480/500VAC plus or minus 10 percent (capable of operation to 550VAC), 3-phase, 48 to 63Hz or Input 208/220/230/240VAC plus or minus 10 percent, 3-phase, 48 to 63Hz.
 2. Output 0 - Input Voltage, 3-phase, 0 to 500Hz for drives up to 75 HP; 0 to 120Hz for drives over 75 HP.
 3. Environmental Operating Conditions: 0 to 40C at 3kHz switching frequency, 0 to 3300-feet above sea level, less than 95 percent humidity, noncondensing.
 4. Enclosure rated Type 1.
- C. Standard Features:
 1. Provide VFDs with the same customer interface, including digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for local control (start/stop, forward/reverse, and speed adjust), for setting parameters, and for stepping through the displays and menus.
 2. Fault Mode on Loss of Input:
 - a. Displaying a fault.
 - b. Running at a programmable preset speed as selected by user.
 3. Utilize English digital display (code numbers are not acceptable). Digital Display: A 40 character (2 line by 20 characters/line) LCD display, backlit to provide easy viewing in light condition, adjustable contrast to optimize viewing at angles display. Set-up parameters, indications, faults, warnings and other information in words to allow the user to understand what is being displayed without the use of a manual or cross reference table.
 4. Utilize preprogrammed application macro's specifically designed to facilitate start-up. Provide one command to reprogram parameters and customer interfaces for a particular application to reduce programming time.
 5. Automatic restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts to be programmable. If the time between reset attempts is greater than zero, the time remaining until reset occurs to count down on the display to warn an operator that a restart will occur.
 6. Capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
 7. Automatic extended power loss ride-through circuit.
 8. Customer terminal strip isolated from the line and ground.
 - a. Prewired three-position Hand-Off-Auto switch and speed potentiometer. When in "Off" the VFD will be stopped. When in "Auto" the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.
 9. Current Limit Circuits to Provide Trip Free Operation:

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- a. Slow current regulation limit circuit adjustable to 125 percent (minimum) of the VFDs variable torque current rating. Adjustment made via the keypad, and displayed in amps.
 - b. Rapid current regulation limit adjustable to 170 percent (minimum) of the VFDs variable torque current rating.
 - c. Current switch off limit fixed at 255 percent (minimum, instantaneous) of the VFDs variable torque current rating.
10. Overload Rating: 110 percent of its variable torque current rating for 1 minute every 10 minutes, and 140 percent of its H torque current rating for 2 seconds every 15 seconds.
11. DC Line Reactor to reduce the harmonics to the power line.
12. Optimized for a 3 kHz carrier frequency to reduce motor noise.
13. Manual speed potentiometer or keypad as a means of controlling speed manually.
- D. Adjustments:
1. Five programmable critical frequency lockout ranges.
 2. PI setpoint controller.
 3. Two programmable analog inputs for reference for PI controller. Analog Inputs: Include filters; programmable from 0.01 to 10 seconds to remove oscillation in the input signal.
 4. Six programmable digital inputs for maximum flexibility in interfacing with external devices.
 5. Two programmable analog outputs proportional to frequency, motor speed, output voltage, output current.
 6. Two independently adjustable accel and decel ramps. Ramp times adjustable from 1 to 1800 seconds.
 7. The VFD to ramp or coast to a stop, as selected by user.
- E. Display: The following operating information displays to be standard on the VFD digital display.
1. Output Frequency
 2. Motor Speed (RPM, percent or engineering units)
 3. Motor Current
 4. Calculated Motor Torque
 5. Calculated Motor Power
 6. Output Voltage
 7. Analog Input Values
 8. Keypad Reference Values
 9. Elapsed Time Meter
 10. kWh Meter
- F. Protection Circuits: In the case of a protective trip, stop the drive and announce the fault condition.
1. Overcurrent trip 315 percent instantaneous (225 percent RMS) of the VFDs variable torque current rating.
 2. Overvoltage trip 130 percent of the VFD's rated voltage.
 3. Undervoltage trip 65 percent of the VFD's rated voltage.
 4. Overtemperature plus 70C (ACH 501); plus 85C (ACH 502).
 5. Ground Fault either running or at start.
 6. Adaptable Electronic Motor Overload (I2t).
- G. Speed Command Input Via:
1. Keypad.
 2. Two analog inputs, each capable of accepting a 0 to 20mA, 4 to 20mA, 0 to 10V, 2 to 10V signal. Analog inputs programmable filter to remove an oscillation of the reference signal. Minimum and maximum values (gain and offset) adjustable within the range of 0 to 20mA and 0 to 10V.
- H. Accessories:

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1. Door interlocked thermal magnetic circuit breaker disconnect handle, through-the-door type, and padlockable in the "Off" position.
2. Fused disconnects for each motor.
3. Trouble output contact.
4. Include a set of contacts that signal the building automation system to open VAV boxes to 100 percent during bypass mode.
5. Output filter to provide for wave shaping.
6. Provide 5 percent impedance 3-phase line reactor on the input side of the VFD.

2.5 DISCONNECTS

- A. Provided by Division 26, Electrical unless specified otherwise.

PART 3 - EXECUTION

3.1 GENERAL

- A. Electrical Requirements:
 1. Contractor to Provide the Following:
 - a. Motors.
 - b. Starters and disconnects that are integral parts of plumbing equipment as shown on the equipment schedules. Reference Drawings and subsequent Sections. Provide a working system. Coordinate with Division 26, Electrical.
 - c. Low Voltage and Electronic Control Devices.
 - d. Low Voltage Transformers.
 - e. Low Voltage Conduit and Wire and Connecting Devices.
 - f. Conduit and wire for electronic devices, except for line voltage wiring.
 2. Electrical work listed above performed by a licensed electrical contractor or by the control manufacturer, but provided for and coordinated under Division 22, Plumbing work. In addition, controls work supervised and subsequently approved in writing by the control manufacturer.
 3. Contractor to furnish the following to the Electrical Contractor where applicable: Line voltage control equipment, including switches (except disconnects), time switches, transformers, relays, etc. (except those part of MCC).
 4. Include the Following Items under Division 26, Electrical Work:
 - a. Line voltage wire and conduit system.
 - b. Disconnects not provided with equipment.
 - c. Installation of line voltage control equipment supplied by Division 22.
- B. Electrical Interlocks: Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize mechanical equipment wiring diagrams to coordinate with the electrical systems so that proper wiring of the equipment involved is affected.
- C. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.
- D. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- E. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.
- F. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency and latest EPACT.
- G. Vertical in-line pump motors per NEMA MG1 vertical motor requirements.
- H. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

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- I. Check line voltage and phase and ensure agreement with nameplate.
- J. Verify motor rotation.
- K. Field Quality Control:
 - 1. Prepare for Acceptance Tests as Follows:
 - a. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - b. Test interlocks and control features for proper operation.
 - c. Verify that current in each phase is within nameplate rating.
 - 2. Testing: Perform the Following Field Quality-Control Testing:
 - a. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
 - b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - a. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with requirements.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - c. Verify bearing lubrication.
 - d. Verify proper motor rotation.
 - e. Test Reports:
 - 1) Prepare a written report to record the following test procedures used:
 - (a) Test results that comply with requirements.
 - (b) Test results that do not comply with requirements and corrective action taken to achieve compliance.
- L. Adjusting: Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
- M. Cleaning:
 - 1. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
 - 2. Clean motors, on completion of installation, according to manufacturer's written instructions.

3.2 GENERAL MOTOR CONSTRUCTION AND REQUIREMENTS

- A. Motor Installation: Install in accordance with manufacturer's instructions. Coordinate with starter or variable speed controller with control sequence to provide necessary starter accessories.

3.3 STARTERS

- A. Install starters in accordance with manufacturer's instructions.
- B. Coordinate disconnect requirements and location with Division 26, Electrical if not integral to starter. If starter is installed out of line of sight of motor, provide additional disconnect at motor per code.
- C. Provide NEMA housing appropriate to installation location.
- D. Provide supports and install securely, in neat and workmanlike manner, as specified in NECA 1.
- E. Meet mounting height and accessible location requirements per local code.
- F. Provide fuses for fusible switches.
- G. Select and install overload heater elements in motor starters to match installed motor characteristics.
- H. Single phase 120 volt starter: If not furnished as single packaged controller/disconnect, provide contactors, relays, wiring, and devices necessary to match sequence of operation

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for equipment.

3.4 VARIABLE FREQUENCY DRIVES

- A. Variable Speed Controller Connection:
 - 1. Coordinate wiring length/type to meet controller manufacturer's requirements. Provide grounding per manufacturer's wiring diagram.
 - 2. Shaft Grounding:
 - a. Provide shaft grounding assembly on motors controlled by variable frequency drive. Shaft grounding device to be in the form of brush that resides on the motor shaft. Brush assembly to be capable of tolerating misalignment and maintaining rotating contact throughout the motor's life.
 - b. Material: Material used in the grounding assembly to be of stable material commonly used within industry that is not believed to constitute a hazardous material under Occupational Safety and Health Administration (OSHA) regulations.
 - c. Brushes: Specifically developed carbon compounds of sustained performance with seal life expectancy of three years minimum.
 - d. Seals: Sealed type to keep contaminants from entering the shaft grounding system in wet or severe environment applications.
 - e. Shaft Grounding Assembly: For clean room air handling systems, use the type that contains the wear products within a special enclosure within the shaft grounding system.
 - f. Shaft grounding assembly installation not to affect the motor manufacturer warranty. Where the severe environment conditions require application of the shaft grounding types that are screwed into the motor shaft, the installation of the shaft grounding system performed either by the motor manufacturer or by the motor manufacturer authorized facility.
 - g. Bond the brush to the closest ground point using code sized green insulated stranded copper conductor per manufacturer instructions.
 - h. Test and verify the performance of the assembly to ensure that under no conditions the shaft exceeds three volts.
 - 3. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
 - 4. Check line voltage and phase and ensure agreement with nameplate.
 - 5. Verify motor rotation.
- B. Ensure the area where the variable frequency drive is to be installed is within the range of ambient temperatures set by the manufacturer.
- C. Ensure grounding and bonding is per manufacturer's recommendations.
- D. Install per manufacturer's recommendations.
- E. Install per NEC requirements.
- F. Coordinate with Division 26, Electrical.

3.5 DISCONNECTS

- A. Provided by Division 26, Electrical unless specified otherwise.
- B. Provide disconnecting means within sight of each motor controller and of each motor. Motor controller disconnecting means equipped with lock-out/tag-out padlock provisions do not require a disconnect switch at the controlled motor location. Locate disconnect means in view of and not inside of equipment, such that tools are not needed to remove covers to access the disconnecting means.
- C. Install in accordance with manufacturer's instructions.
- D. Install fuses in fusible disconnect switches. Coordinate fuse ampere rating with installed equipment. Do not provide fuses of lower ampere rating than motor starter thermal units.
- E. Controllers:

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1. Single Phase 120 Volt Starter: If not furnished as single packaged controller/disconnect, provide contactors, relays, wiring, and devices necessary to match sequence of operation for equipment.

END OF SECTION

**SECTION 22 05 19
PLUMBING DEVICES**

SECTION 22 05 19 - PLUMBING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Pressure Gauges
 - 2. Thermometers
 - 3. Thermometer Wells
 - 4. Pressure-Gauge Fittings
 - 5. Flow Indicators
 - 6. Water Hammer Arrestors (Shock Absorbers)
 - 7. Trap Primers
 - 8. Water Filters

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pressure Gauges:
 - 1. Dwyer Instruments, Inc.
 - 2. Moeller Instrument Co., Inc.
 - 3. Omega Engineering, Inc.
 - 4. Trerice
 - 5. Or approved equivalent.
- B. Thermometers:
 - 1. Ashcroft
 - 2. Trerice
 - 3. Weiss
 - 4. Marshalltown
 - 5. Weksler
 - 6. Or approved equivalent.
- C. Thermometer Wells:

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1. Ashcroft
 2. Omega
 3. Weiss
 4. Or approved equivalent.
- D. Pressure Gauge Fittings:
1. Omega
 2. Weiss
 3. Trerice
 4. Or approved equivalent.
- E. Flow Indicators:
1. LJ Starr
 2. Dwyer
 3. Or approved equivalent.
- F. Water Hammer Arrestors (Shock Absorbers):
1. Piston Type:
 - a. MIFAB
 - b. PPP
 - c. Sioux Chief
 - d. Or approved equivalent.
- G. Trap Primers:
1. J.R. Smith
 2. MIFAB
 3. PPP
 4. Wade
 5. Zurn
 6. Or approved equivalent.
- H. Water Filters:
1. Cuno
 2. Or approved equivalent.

2.2 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, phosphor-bronze bourdon type, dry type.
1. Case: Cast aluminum, stem-mounted, flange less.
 2. Size: 4-1/2-inch diameter.
 3. Window: Clear glass.
 4. Connector: Brass.
 5. Scale: White aluminum with black graduation and markings.
 6. Pointer: Black, adjustable.
 7. Mid-Scale Accuracy: One percent.
 8. Scale: PSI and KPa.
 9. Basis of Design: Trerice Model 600CB.

2.3 THERMOMETERS

- A. Thermometers - Adjustable Angle: Red or blue appearing organic liquid in glass, ASTM E 1; 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.
1. Size: 9-inch scale.
 2. Window: Acrylic.
 3. Scale: Aluminum, white background, black graduations and markings.
 4. Stem: 3/4-inch NPT brass.
 5. Accuracy: 2 percent, per ASTM E 77.
 6. Calibration: 0-160 with 2 Degrees F graduations.
 7. Basis of Design: Trerice BX9.

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2.4 THERMOMETER WELLS

- A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
 - 1. Material: Brass for use in copper piping.
 - 2. Material: Stainless steel, for use in steel piping.
 - 3. Extension Neck Length: Nominal thickness of 2-inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
 - 4. Insertion Length: To extend to center of pipe.
 - 5. Cap: Threaded, with chain permanently fastened to socket.
 - 6. Heat Transfer Fluid: Oil or graphite.

2.5 PRESSURE-GAUGE FITTINGS

- A. Valves: NPS 1/4 (DN8) brass or stainless-steel needle type.
- B. Siphons: NPS 1/4 (DN8) coil of brass turbine with threaded ends.
- C. Snubbers: ASME B40.5, NPS 1/4 (DN8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.6 FLOW INDICATORS

- A. Description: Instrument for visual verification of flow; made for installation in piping systems.
 - 1. Construction: Bronze or stainless steel body, with sight glass and plastic pelton-wheel indicator.
 - 2. Pressure Rating: 125 PSIG.
 - 3. Temperature Rating: 200 degrees F.

2.7 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)

- A. Bellows-type, stainless steel casing and bellows, pressure rated, tested and certified in accordance with PDI WH-201 or ASSE 1010.
- B. Piston-type, copper, brass or stainless steel with O-ring piston, pressure rated, tested and certified in accordance with PDI WH-201 or ASSE 1010.

2.8 TRAP PRIMERS

- A. Automatic trap primer assemblies meeting governing code requirements. Provide with air-gap fittings as required.
- B. Flush valve tail-piece trap primer. PPP FVP-1VB.
- C. Automatic "Pressure drop activated" lead free trap primer, with 3 psi activation. PPP model PR-500.
- D. Electronic trap seal automatic primer valve with integral anti siphon protection and timer. Coordinate quantity, locations, and voltage characteristics or control points.
- E. Trap seal primer valve (low lead) with integral automatic anti-siphon protection. The priming valve to discharge on both pressure drop and pressure spike. PPP CPO 500.

2.9 WATER FILTERS

- A. Wound-type micronic filter with disposable cartridge. Provide 1 additional set of cartridges for each filter.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. For plumbing devices requiring access from access panels (i.e. trap primers, water hammer arrestors and the like) submit location/size of all access panels to Architect for approval prior to purchase and installation of access panel. See Section 22 00 00, Plumbing Basic Requirements for additional requirements.

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- B. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- C. Install per manufacturer recommendations.

3.2 PRESSURE GAUGES

- A. Install pressure gauge where exposure to heat and vibration are minimal and where the dial can be easily read. It is also important to install the gauge in a location with undisturbed and continuous flow of the pressure medium.
- B. Provide a needle valve or gauge cock, installed between the process and the pressure gauges.
- C. Install pressure gauges in piping tee with pressure gauge cock, in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- D. Locations: Install in the following locations, and elsewhere as indicated.
 - 1. At each pump inlet and outlet.
 - 2. At inlet and discharge of each pressure reducing valve.
 - 3. At make-up water service outlets.
 - 4. At inlets and outlets of all master mixing valves.
- E. Adjust gauges to final angle, clean windows and lenses, and calibrate to zero.
- F. Install per manufacturer recommendations.
- G. Pressure Gauge Range/Graduations:
 - 1. Cold Water: 0-100 PSI; graduation 1 PSI.
 - 2. Hot Water: 0-100 PSI; graduation 1 PSI.

3.3 THERMOMETERS

- A. 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.
- B. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- C. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.
- D. Install per manufacturer recommendations.
- E. Thermometer Range/Graduations:
 - 1. Cold Water: 25-125 degrees F; graduation 1 degree F.
 - 2. Hot Water: 30-240 degrees F; graduation 2 degrees F.

3.4 THERMOMETER WELLS

- A. See "Thermometers" Article above.
- B. Install in piping in vertical upright position. Fill well with oil or graphite, secure cup.
- C. Install per manufacturer recommendations.

3.5 PRESSURE-GAUGE FITTINGS

- A. See "Pressure Gauges" Article above.
- B. Install per manufacturer recommendations.

3.6 FLOW INDICATORS

- A. Check all components carefully for damage incurred during shipment. If damage is discovered or suspected, do not attempt installation.
- B. Ensure the visual flow indicator is free of any damage due to mishandling or improper storage before proceeding with installation. Specific areas of concern are the window and pipe connections.
- C. Examine the window for evidence of scratches, chips, or cracks. If any are present, do not proceed with installation. Surface abrasions weaken the window and it will not be able to support the listed design rating.
- D. The pipe connections, flanged or threaded, must be free of any foreign material. The presence of foreign material may prevent the unit from sealing.

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- E. Install per manufacturer recommendations.
- 3.7 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)
- A. Install in upright position, in locations and of sizes in accordance with PDI WH-201 or ASSE 1010, and elsewhere as indicated.
 - B. Locate shock absorbers in supply pipe in accordance with recommendations of Plumbing and Drainage Institute PDI-WH201 or ASSE 1010. Install ahead of solenoid operated valves. Determine size of absorber by fixture unit value of fixture supplied, using PDI symbols to designate sizes. Provide access panel for each shock absorber.
 - C. Install per manufacturer recommendations.
- 3.8 TRAP PRIMERS
- A. Flush supply line prior to installation.
 - B. Install valve plumb using caution to not over-tighten.
 - C. Effective operating range 20 to 80 PSIG (138 to 552 kPa).
 - D. Do not subject trap primer valve to pressure in excess of 125 PSI.
 - E. Install trap primer per manufacturer's instructions. Install primer outlets a minimum of 12-inches above finished floor. For installations with primer lines in excess of 20 feet in length, the primer assembly should be raised 12-inches for each additional 20 feet of length. Maximum 80 feet primer length unless specifically approved by design engineer.
 - F. Install primers at locations as indicated on Drawings. Extend primer lines to all trapped drains that are tied to sanitary.
 - G. Provide the number of primer assemblies required at each primer "location" to feed the number of primer lines at that location.
 - H. For electronic primers assemblies, coordinate required electrical connections with Division 26.
- 3.9 WATER FILTERS
- A. Attach the mounting bracket to the filter head with screws.
 - B. Install filter cartridge into filter head. Position filter bracket by holding it up against the mounting surface. Allow at least 2-inches of clearance below the cartridge to facilitate cartridge removal. Mark the mounting hole locations onto the mounting surface. Secure bracket to mounting surface using appropriate mounting hardware. The unit may be mounted either vertically or horizontally. The inlet/outlet connections are typically female pipe threads. Appropriate fittings/piping/tubing tools vary by requirements of each installation. Shut-off valves must be installed on both the inlet and outlet water lines. Be sure to always use Teflon Tape to seal tapered threads. Important: Do not use acid base pipe sealers or wicking on plastic filter head.
 - C. Make any required connections and pressurize system to check for leaks. If none are apparent, flush new cartridge for a minimum of five minutes to remove any trapped air or carbon fines. The filter system is now ready for service.
 - D. Install per manufacturer recommendations.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Valves, General
 - 2. Balancing Valves
 - 3. Ball Valves
 - 4. Swing Check Valves
 - 5. Backflow Prevention Assemblies
 - 6. Pressure Regulating Valve - Domestic Water
 - 7. Thermostatic Master Mixing Valves (ASSE 1017 Rated)
 - 8. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated)

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G and/or NSF/ANSI 372 for potable water services. Valves must be 3rd-party certified.
 - 2. ISO 9001 Certified.
 - 3. IAPMO Certified for Low Lead.
- C. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- D. Model numbers indicated as Basis-of-Design indicate valve characteristics. All valves are to meet code Low Lead/Lead Free Standards.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- B. Valves, General:
 - 1. Apollo
 - 2. Armstrong

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3. ASCO
 4. Caleffi
 5. Cla-Val
 6. Conbraco
 7. Crane
 8. Clow
 9. Griswold
 10. Hammond
 11. Hays
 12. Jenkins
 13. Josam
 14. Kennedy
 15. Milwaukee
 16. Mueller
 17. Nibco
 18. Red-White Valve
 19. Smith
 20. Stockham
 21. Tour Anderson
 22. Wade
 23. Watts
 24. Wilkins
 25. Zurn
 26. Or approved equivalent.
- C. Balancing Valves:
1. Caleffi
 2. Griswold
 3. Hays
 4. Armstrong CBV
 5. Tour Anderson
 6. Or approved equivalent.
- D. Ball Valves:
1. See Valves, General above.
 2. NSF Valves:
 - a. Clow
 - b. Kennedy
 - c. Nibco
 - d. Or approved equivalent.
- E. Swing Check Valves:
1. See Valves, General above.
- F. Backflow Prevention Assemblies:
1. Backflow Preventers:
 - a. Apollo
 - b. Cla-Val
 - c. Conbraco
 - d. Watts
 - e. Or approved equivalent.
 2. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-inches and Smaller:
 - a. Febco 850-650A
 - b. Conbraco Apollo 40-110-T2
 - c. Watts 007-QT-FDA-S
 - d. Wilkins 350-S-XL
 - e. Or approved equivalent.
 3. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-1/2-inches and Larger:

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- a. Conbraco Apollo 45-11-1
- b. Watts LF-709 with 77F-01-FDA-12
- c. Or approved equivalent.
- 4. Spill Resistant Pressure Vacuum Breaker:
 - a. Febco
 - b. Conbraco
 - c. Watts
 - d. Wilkins
 - e. Or approved equivalent.
- 5. Atmospheric Vacuum Breakers:
 - a. Febco
 - b. Conbraco
 - c. Watts
 - d. Wilkins
 - e. Or approved equivalent.
- G. Pressure Regulating Valve-Domestic Water:
 - 1. Cash Acme
 - 2. Cla-Val
 - 3. Watts
 - 4. Wilkins
 - 5. Or approved equivalent.
- H. Thermostatic Master Mixing Valves (ASSE 1017 Rated):
 - 1. Caleffi
 - 2. Holby Tempering Valve
 - 3. Lawler Series 66
 - 4. Leonard Type TM
 - 5. Powers LFMM430 (Lead Free)
 - 6. Symmons Temp Control Series 5
 - 7. Or approved equivalent.
- I. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated):
 - 1. Caleffi
 - 2. Lawler
 - 3. Leonard
 - 4. Powers Hydroguard
 - 5. Or approved equivalent.

2.2 VALVES - GENERAL

- A. General:
 - 1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
 - 2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6-inches and smaller. Provide gear operators for quarter-turn valves 8-inches and larger and plug valves installed over 5-feet above finished floor.
 - 3. Valve Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body.
- B. Valves in Insulated Piping: With 2-inch stem extension and following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation on valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.
- C. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With thread according to ASME B1.20.1.

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GENERAL-DUTY VALVES FOR PLUMBING PIPING

- D. Valve Bypass and Drain Connections: MSS SP-45.
- E. Building Service:

- 1. Shutoff and Isolation Valves:
 - a. Pipe Sizes 3-inches and Smaller: Ball Valve.
- 2. Drain Service: Ball Valves.
- 3. Strainer Blow-Off: Ball Valve.
- 4. Check Valves: Swing.

2.3 **BALANCING VALVES**

- A. Maximum 125 PSIG System Working Water Pressure.
- B. Manual Set Balancing Valves:
 - 1. Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive drip-tight shut-off.
 - 2. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators located on the valve handwheel. Valves have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valves to be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi to have two 1/4-inch threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves to be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug to be brass. The handwheel to be high-strength resin.
 - 3. 2-1/2-inch and Larger: Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive drip-tight shut off. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators location on the valve handwheel. Valves to have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valve body to be either cast iron with integrated cast iron flanges (2-1/2-inch to 12-inch) or ductile iron with industrial standard grooved ends (2-1/2-inch to 12-inch). Valve stem and plug disc to be bronze with handwheel that permits multi-turn adjustments. Sizes 2-1/2-inch and 3-inch: five turns; sizes 4-inch to 6-inch: 6 turns; sizes 8-inch to 10-inch: 12 turns; and size 12-inch: 14 turns. Flange adapters to be provided to prevent rotation.
- C. Automatic Flow Control Valve:
 - 1. 1/2-inches and Larger: Construction and attachment style as required by piping system. Internal working parts and removable flow cartridge stainless steel. Valves to be factory set and automatically limit flow to specified capacities with 5 percent plus or minus accuracy over entire operating pressure differential.
 - 2. Provide a shut-off valve on the supply side of the control valve and a check valve on the discharge side of the control valve.
 - 3. Minimum Flow Through Valve:
 - a. 1/2-inches size: 1 gpm.
 - b. 3/4-inches size: 1.5 gpm.

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GENERAL-DUTY VALVES FOR PLUMBING PIPING

2.4 BALL VALVES

- A. All ball valves on brazed piping are to be three-piece.
- B. 2-1/2 Inches and Smaller: MSS SP-110, 400-600 PSI, two-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 77CLF 100 Series two-piece.
- C. 3 Inches and Larger: MSS SP-110, 400-600 PSI, three-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 82-100/82A 140 Series three-piece.
- D. Full Port Ball Valve: 2- to 4-inch ductile iron, ASTM A536, micro finish steel chrome plated or stainless steel ball and stem. TFE seats, 600 PSI.

2.5 SWING CHECK VALVES

- A. 2-inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413. MSS SP-80.
- B. 2-1/2-inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918. MSS SP-71.
- C. Rubber Flapper Check Valve: Horizontal or vertical upward flow installation. Working pressure to 175 PSI. Ductile iron or cast iron body. Steel reinforced Buna-N rubber flapper epoxy coating on wetted parts. MSS SP-80.
- D. Gruvlok Series 7800 Check Valve: Horizontal installation. Working pressure to 300 PSI, Type 304/302 Stainless Steel conforming to ASTM 167. Ductile body, ASTM A536, and stainless clapper, EPDM, nitrile or optional viton bumper and bonnet seals. Stainless wetted parts.

2.6 BACKFLOW PREVENTION ASSEMBLIES

- A. General: Assemblies model numbers listed below are for general comparison. Project specific model numbers to be verified contractor as approved by jurisdiction where project is located.
- B. Double Check Valve Assembly (DCVA) for Low Hazard Applications:
 - 1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and FDS strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Bronze construction, threaded ends, and stainless steel internal parts.
 - 2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Epoxy coat cast iron body construction, strainer flanged ends, and stainless steel internal parts.
- C. Spill Resistant Pressure Vacuum Breaker: Watts Model 800MCQT with 777S "Y" strainer.
- D. Atmospheric Vacuum Breaker: Assembly consists of a bronze vacuum breaker body with silicone disc, and full size orifice. Device to be IAPMO listed, meet ASSE standard 1001, and ANSI standard A113.1.1 rough chrome plate finish.

2.7 PRESSURE REGULATING VALVE - DOMESTIC WATER

- A. Water: Bronze body, diaphragm or piston type, spring actuated, with separate or integral stainless steel strainer, pressure range to suit conditions, approved for potable water use, low lead. Provide shutoff valves, pressure relief valves, unions, drain valve and bypass.
- B. Water: Automatic control pressure regulating valve, stainless steel seat, stem and spring, diaphragm actuated with brass body, hydraulic control pilots with effluent operating temperature range 32 degrees F to 180 degrees F, FDA and AWWA approved.
- C. Water: Bronze body construction, stainless steel strainer screen, thermal expansion bypass with renewable stainless steel seat and high temperature resisting diaphragm.

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- 2.8 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)
- A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1017.
 - B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.
 - C. Flow from the tempered water circulating pump to be split to mixing valve and building hot water heating system.
- 2.9 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)
- A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1070.
 - B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.

PART 3 - EXECUTION

- 3.1 GENERAL INSTALLATION REQUIREMENTS
- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Block check valves in either closed or open position.
 - B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
 - C. Inspect the shipping container before unpacking to look for damage that could have occurred during transport, and report it to the transportation company immediately. After visual inspection, remove the valve from the shipping container. Make sure the faces are free of any scratches and that there is not any obvious damage to the actuator assembly or valve body.
 - D. Make sure to note the valve's model number during the unpacking process. The model number will need to be provided when purchasing replacement parts.
 - E. Purge and clean all piping to be connected to valve.
 - F. Install per manufacturer's recommendations.
 - G. Determine that the valve and its plumbing piping is adequately supported when installed. If a valve is not adequately supported, this could prevent the valve from operating and sealing correctly. Be sure that all mating flanges are in line and parallel to minimize straining on joints and valve body.
 - H. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
 - I. Do not attempt to repair defective valves; replace with new valves.
 - J. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
 - K. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose end adapter and cap on chain for each valve that must be installed with

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GENERAL-DUTY VALVES FOR PLUMBING PIPING

- stem below horizontal plane. Ensure installation provides full stem movement.
- L. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.
 - M. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5-feet above floor and hook to clips to clear aisle passage.
 - N. Stem Selection: Outside screw and yoke stems, except provide inside screw, non-rising stem where space prevents full opening of OS&Y valves.
 - O. Seats: Renewable seats, except where otherwise indicated.
 - P. When soldering, use paste flux that are approved by the manufacturer for use with lead free alloys.
 - Q. If valve applications are not indicated on Drawings, use the following:
 - 1. Shutoff Service: Ball valves.
 - R. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
 - S. Valves, except wafer/butterfly types, with the following end connections:
 - 1. For Copper Tubing, 2-inches and Smaller: Threaded ends except where solder-joint valve-end.
 - 2. For Copper Tubing, 2-1/2-inches to NPS 4-inches: Flanged ends except where threaded valve-end.
 - 3. For Copper Tubing: 5-inches and Larger: Flanged ends.
 - 4. For Steel Piping, 2-inches and Smaller: Threaded ends.
 - 5. For Steel Piping, 2-1/2-inches to NPS 4-inches: Flanged ends except where threaded valve-end.
 - 6. For Steel Piping, 5-inches and Larger: Flanged ends.
 - T. Valve Adjusting and Cleaning:
 - 1. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
 - 2. Valve Identification. Tag valves per Section 22 05 53, Identification for Plumbing Piping and Equipment.
- 3.2 **BALANCING VALVES INSTALLATION**
- A. See General Installation Requirements above.
 - B. Install with flow in the direction of the arrow on the valve body and installed at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream from the balancing valve should be free of any fittings. When installed, easy and unobstructed access to the valve handwheel and metering ports for adjustment and measurement are to be provided. Mounting of valve in piping must prevent sediment build-up in metering ports.
- 3.3 **BALL VALVES INSTALLATION**
- A. See General Installation Requirements above.
- 3.4 **SWING CHECK VALVES INSTALLATION**
- A. See General Installation Requirements above.
 - B. Swing Check Valve Installation: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow. Only install where there are 10 pipe diameters of straight pipe upstream of valve.
 - C. Domestic Water and Circulation Pump Discharge Check Valves:
 - 1. 2-inches and Smaller: Bronze body, spring loaded, lead free, lift check.
 - 2. 2-1/2-inches and Larger: Wafer style, silent lift check valve, lead free.
- 3.5 **BACKFLOW PREVENTION ASSEMBLIES INSTALLATION**
- A. See General Installation Requirements above.
 - B. Install where indicated, and where required by code. Where practical, locate in same room as equipment being protected.

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- C. Submit product cut sheets to local AHJ for approval prior to purchase and installation.
- D. Install as close to wall as possible with clearances for access and maintenance as required by AHJ.
- E. Coordinate exact location of installation and type of backflow device serving a particular piece of equipment with AHJ and Architect prior to purchase and installation.
- F. Provide wall/floor brackets that are of fully welded, hot dipped galvanized construction, fabricated to meet field conditions. Mount backflow preventer to brackets using cadmium plated "U" type bolts and nuts.
- G. Contact local water district/backflow specialist and request backflow installation requirements. Install backflow devices per UPC and local water district/backflow specialist requirements.
- H. Route waste piping from air gap waste fitting concealed within walls to point of air gap termination at indirect waste receptor.
- I. Follow local codes for installation requirements. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. Provide a strainer ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve in line with arrow on valve body pointing in the direction of flow. It is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

3.6 PRESSURE REGULATING VALVE - DOMESTIC WATER INSTALLATION

- A. See General Installation Requirements above.
- B. Install valve in the line with arrow on valve body pointing in the direction of flow. This valve should be installed where it is accessible with sufficient clearance for cleaning, service or adjustment. Install the reducing valve before a sill cock line if possible. Before installing the reducing valve hose bibb, flush out the line to remove loose dirt and scale which might damage valve disc and seat.
- C. Horizontal installation is recommended. However, valve can be installed in a vertical position. Regulator must be installed in an accessible location to facilitate servicing the regulator.
- D. To readjust reduced pressures, loosen adjusting screw nut and turn adjusting screw clockwise to raise reduced pressure and counterclockwise to lower reduced pressure.
- E. When reducing valve is used, it makes a closed system; therefore, pressure relief protection must be provided on the downstream side of the reducing valve to protect equipment.
- F. Provide pressure relief valve and terminate discharge to indirect waste receiver.
- G. Anytime a reducing valve is adjusted, the use of a pressure gauge is recommended to verify correct pressure setting. Do not bottom out adjusting screw or spring cage.
- H. Provide inlet and outlet ball valves, and globe valve bypass. Provide pressure gauge on valve outlet.
- I. Provide pressure relief valve piped full size to indirect waste receiver or floor drain.
- J. Provide factory startup on automatic control valves.

3.7 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED) INSTALLATION

- A. See General Installation Requirements above.
- B. Install mixing valve per manufacturer's instruction manual.

3.8 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED) INSTALLATION

- A. See General Installation Requirements above.
- B. Install mixing valve per manufacturer's instruction manual.

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Pipe Hangers and Supports for Plumbing Piping and Equipment
 - 2. Wall and Floor Sleeves
 - 3. Building Attachments
 - 4. Flashing
 - 5. Miscellaneous Metal and Materials

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.
 - 2. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.
 - 3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports."
 - 4. Install piping per SMACNA's requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. General - Provide pipe and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for piping are not shown on the Drawings, the contractor is responsible for their design.
 - 2. Connections to structural framing are not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
 - 1. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
 - 2. Equipment and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.

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- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- E. Provide seismic restraint hangers and supports for piping and equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pipe Hangers and Supports for Plumbing Piping and Equipment:
 - 1. Pipe Hangers/Supports:
 - a. B-Line Systems Inc.
 - b. Anvil International
 - c. HOLDRITE
 - d. Erico Co. Inc.
 - e. Snappitz Thermal Pipe Shield Manufacturing
 - f. Rilco Manufacturing Co. Inc.
 - g. Nelsen-Olson Inc.
 - h. Or approved equivalent.
 - 2. Channel Support Systems:
 - a. B-Line Systems Inc.
 - b. Anvil International, Anvit-Strut
 - c. Erico Hanger Co. Inc.; O-Strut Div.
 - d. Unistrut Corp.
 - e. HOLDRITE EZ-Strut Systems
 - f. Or approved equivalent.
 - 3. Thermal-Hanger Shield Inserts:
 - a. Erico Hanger Co. Inc.
 - b. Pipe Shields, Inc.
 - c. Rilco Manufacturing Co. Inc.
 - d. HOLDRITE Insulation Couplings
 - e. Or approved equivalent.
 - 4. Pipe Alignment and Secondary Supports:
 - a. HOLDRITE
 - b. Starquick
 - c. Or approved equivalent.
 - 5. Tank Seismic Restraint System:
 - a. HOLDRITE
 - b. Spacemaker
 - 6. Wall Mounted Tank Platform:
 - a. HOLDRITE
 - b. Spacemaker
 - c. Or approved equivalent.
 - 7. Floor Mount Platform:
 - a. HOLDRITE
 - b. Spacemaker
 - c. Or approved equivalent.
- B. Wall and Floor Sleeves:
 - 1. Below Grade and High Water Table Areas:
 - a. Modular Link Sealing System at Pipe Sleeves:
 - 1) Thunderline Corporation
 - 2) Or approved equivalent.
 - 2. Pre-Engineered Firestop Pipe Penetration Systems:
 - a. HOLDRITE HydroFlame

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- b. Proset
 - c. Or approved equivalent.
- C. Building Attachments:
 - 1. Anchor-It
 - 2. Gunnebo Fastening Corp.
 - 3. ITW Ramset / Red Head
 - 4. Masterset Fastening Systems, Inc.
 - 5. Or approved equivalent.
- D. Flashing:
 - 1. Fastenal
 - 2. Or approved equivalent.
- E. Miscellaneous Metal and Materials:
 - 1. See Miscellaneous Metal and Materials article below.
 - 2. Powder-Actuated Fastener Systems:
 - a. Gunnebo Fastening Corp.
 - b. Hilti, Inc.
 - c. ITW Ramset / Red Head
 - d. Masterset Fastening Systems, Inc.
 - e. Or approved equivalent.

2.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:
 - 1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance manufacturer's published product information.
 - 2. Use only one type by one manufacturer for each piping service.
 - 3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
 - 4. Provide copper-plated hangers and supports for uninsulated copper piping systems.
 - 5. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
 - 6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or approved equivalent.
- B. Pipe Hangers, Guides and Channel Systems:
 - 1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
 - 2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
 - 3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or approved equivalent. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
 - 4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
 - 5. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A1011 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves

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and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.

- C. Pipe Saddles and Shields:
 - 1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 - 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.
 - 1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
 - 2. Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate.
 - 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
 - 5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
 - 6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360 degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.
- E. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- F. Below Ground:
 - 1. Pipe Hangers: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 316. MSS Type 1. If PVC piping to be used, provide Type 1 hanger, coated for PVC piping.
 - 2. Rod: 5/8-inch stainless steel Type 316.
 - 3. Eyebolt: Stainless steel Type 316.
 - 4. Nuts and Washers: Stainless steel Type 316.
- G. Hangers for Pipe Size 2-inches and Smaller:
 - 1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.
- H. Hangers for Pipe Size 2-1/2-inches and Larger:
 - 1. Adjustable clevis type, UL listed, Type 1.
- I. Riser Clamps:
 - 1. Steel, UL listed. MSS Type 8.
- J. Plumbers Tape:
 - 1. Not permitted as pipe hangers or pipe straps.
- K. Pipe Alignment and Secondary Support Systems:
 - 1. Secondary Pipe supports for general applications (Non-Acoustical).
 - a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
 - b. Supports may be used when sound and/or vibration transfer is not a concern.
 - 2. Secondary pipe supports for sound and vibration attenuation (Acoustical).
 - a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
 - b. Acoustical pipe supports will be manufactured and installed in compliance with International Organization for Standardization (ISO)

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- 3822-1 with current amendments.
- c. Supports will be used when sound and/or vibration transfer is a concern. Locations where acoustical supports will be provided and include but are not limited to partition walls between living units, tenant spaces, retail units, mechanical rooms and lobbies.
 - d. Support Products:
 - 1) Support to Wall Brace and Wall Stud Penetrations: HOLDRITE #261, #262, #263, and #264, or approved equivalent.
 - 2) Pipe Wrap for Pipe Clamps and Channel-Mounted Pipe Clamps: HOLDRITE #270, or approved equivalent.
 - 3) Pipe Wrap for Pipe Hangers: HOLDRITE #271, #272-2, and #272-4, or approved equivalent.
 - 4) Drop-Ear Fitting Support: HOLDRITE #265, or approved equivalent.
 - 5) Floor Riser Isolation Pads: HOLDRITE #275-T, or approved equivalent.
 - 6) Floor Isolation Pads (General Applications): HOLDRITE #274, #275, #276, and #278, or approved equivalent.
 - L. Tank Seismic Restraint Systems:
 - 1. Constructed of galvanized or stainless steel metal with steel wall attachments meeting local seismic requirements.
 - 2. Provide with strap tightening mechanism to ensure seismic restraint of full tank.
 - M. Wall Mounted Tank Platform:
 - 1. Constructed of galvanized or stainless steel metal with steel support brackets and wall attachments meeting local seismic requirements.
 - 2. Provided with welded steel, threaded drain fitting.
 - N. Floor Mount Platform:
 - 1. Constructed of galvanized or stainless steel metal with steel attachments meeting local seismic requirements.
 - 2. Platforms to be rated specifically total tank system wet weight rating and size.

2.3 WALL AND FLOOR SLEEVES

- A. Below Grade and High Water Table Areas:
 - 1. Modular Link Sealing System at Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Use a modular link sealing system at sleeves to continuously fill the annular space between the pipe and the wall opening. Provide Link-seal Type C unless otherwise noted. OS with S-316 stainless construction for continuous water/tank walls.
 - 2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51. Pipe sleeve will extend a minimum of 6-inches beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with project's structural engineer. In areas with a high water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.
- B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
- C. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.
- D. Fabricated Accessories:
 - 1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 - 2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
 - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
 - b. Sleeve Sizes 5-inches to 6-inches: 16 gauge.
 - c. Sleeve Sizes 7-inches and Larger: 14 gauge.

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- d. Fire-Rated Safing Material:
 - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
 - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.4 BUILDING ATTACHMENTS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project Structural Engineer. Provide anchor bolts suitable for cracked concrete.
- B. Anchor Bolts:
 - 1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 - 2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 - 3. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.
- C. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- D. Powder-Actuated Drive Pin Fasteners:
 - 1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- F. Grout: ASTM C1107, Grade B, factory mixed and packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and non-gaseous.
 - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.5 FLASHING

- A. Steel Flashing: 26 gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.
- D. Provide hot dipped galvanized components for items exposed to weather.

2.6 MISCELLANEOUS METAL AND MATERIALS

- A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.
 - 1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with

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- requirements of ASTM A36 or approved equivalent.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather.
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.
- I. Grout: ASTM C1107, Grade B, factory mixed and packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and non-gaseous.
 - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Examination:
 - 1. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.
- B. Preparation:
 - 1. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate with project structural engineer proper placement of inserts, anchors and other building structural attachments.

3.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- A. Hangers and Supports:
 - 1. Comply with MSS SP-58. Pipe Hanger and Support Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
 - 2. Pipe Ring Diameters:
 - a. Uninsulated and Insulated Pipe, except where oversized pipe rings are specified: Ring inner diameter to suit pipe outer diameter.
 - b. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
 - 3. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
 - 4. Pipe Support Brackets: Support pipe with pipe slides.
 - 5. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.

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6. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - a. Field assemble and install according to manufacturer's written instructions.
7. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field -fabricated, heavy-duty trapezes.
 - a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1
8. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers.
9. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
10. Do not support piping from other piping.
11. Fire protection piping will be supported independently of other piping.
12. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
13. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.
14. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchor, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.
15. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
16. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
17. Insulated Piping (comply with the following):
 - a. Attach clamps and spacers to piping.
 - 1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - 2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - 3) Do not exceed pipe stress limits according to ASME B31.9.
 - b. Install MSS SP-58, Type 39 protection saddles, if insulation without a vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 - c. Install MSS SP-58, Type 40 protective shields on cold piping having a vapor barrier. Shields to span arc of 180 degrees.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 - d. Shield Dimensions for Pipe, not less than the following:
 - 1) NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
 - 2) NPS 4 (DN100): 12-inches long and 0.06-inch thick.
 - 3) NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.

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- 4) NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
 - 5) NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
 - e. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
 - f. Insert Material: Length at least as long as protective shield.
 - g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
18. Equipment Clearances: Do not route equipment or piping through electrical rooms, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-foot lateral clearance from all sides of electric switchgear panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.
19. Pipe supports and hanger spacing (pipe supported from structure or floor-supported) to meet the requirements of References and Standards Article in Part 1 above.
- B. Pipe Curb Assemblies:
1. Provide for piping which penetrates the structural roof deck to service equipment above the roof level (e.g., piping, electrical power and control wiring). Meet requirements of roof warranty.
 2. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.
 3. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise. At roofing applications, the adhesion mastic is to be specifically submitted to and approved by the roofing system manufacturer/installer to maintain the integrity of all warranties.
 4. At concrete floors, install a polyurethane mastic to the support block and adhere in place.
- C. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
 2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.
 3. Riser to be supported at each floor penetration.
 4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.
- D. Adjusting and Painting:
1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
 2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.
- E. Tank Seismic Restraint Systems:
1. Install restraint system per manufacturer's instructions.
 2. Coordinate system attachments to building structure with structural engineer and complete installation in accordance with engineers' requirements.
- F. Wall Mounted Tank Platform:
1. Install restraint system per manufacturer's instructions.
 2. Coordinate system attachments to building structure with structural engineer and complete installation in accordance with engineers' requirements.
- G. Floor Mount Platform:
1. Install restraint system per manufacturer's instructions.

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2. Coordinate system attachments to building structure with structural engineer and complete installation in accordance with engineers' requirements.

3.3 WALL AND FLOOR SLEEVES

- A. Modular Link Sealing System Pipe Sleeves: Install at slab on grade floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations (except for DWV piping at slab on grade). Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.
- B. Fabricated Pipe Sleeves:
 1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirement, and by waterproofing requirements.
 2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
 3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
 4. Seal each end airtight with a resilient nonhardening sealer, UL listed and fire rated per ASTM 814.

3.4 BUILDING ATTACHMENTS

- A. Install within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.
- B. Attachment to Wood Structure: Provide MSS Type 34 for attachment to wooden beam or approved attachment for a wood structure.
- C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- E. Install powder-actuated drive pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Test powder-actuated insert attachments with a minimum load of 100 pounds.
- F. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.
- G. Anchor Bolts:
 1. Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
 2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.
- H. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
- I. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.

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- J. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 - 1. Install fabricated pipe sleeve.
 - 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
 - 3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.
- K. Piping Penetrations Through Fire-Rated (1 to 3 hour) Assemblies:
 - 1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
 - 2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814. Use HOLDRITE HydroFlame or approved equivalent.
- L. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

3.5 FLASHING

- A. Flash and counter flash where piping passes through weather or waterproofed walls, floors and roofs.
- B. Flash vent soil pipes with flashings per Division 01, General Requirements.
- C. Flash floor drains over finished areas and roof drains, 10-inches clear on sides, minimum 36-inches by 36-inches sheet size. See Division 01, General Requirements. Fasten flashing to drain with clamping device.
- D. Install built up fixtures (mop sinks, shower stalls, shower floors) with water sealing systems/membranes to meet Code and as prescribed by Division 01, General Requirements and Section 22 00 00, Plumbing Basic Requirements. Meet all Code testing requirements. Provide drainage devices with appropriate flanges, clamps, etc. to meet these installation requirements and ensure a water-tight installation.

3.6 MISCELLANEOUS METAL AND MATERIALS

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.
- C. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.
- D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- E. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
 - 1. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with

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edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

F. Fabrication:

1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates and similar devices. Hot dip galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.

2. Finishes:

- a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas with primer of same material before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
- b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials:
 - 1) Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
- c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

G. Metal Fabrication:

1. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
3. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of weld and methods used in correcting welding work, and with the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
4. Provide hot dipped galvanized components for items exposed to weather.

**SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

END OF SECTION

SECTION 22 05 48
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Vibration Isolation

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.
 - 1. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
 - 2. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCES AND STANDARDS

- A. References and standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Vibration Isolation:
 - a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
 - b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
 - 1) Equipment mounting holes.
 - 2) Dimensions.
 - 3) Isolation selected for each support point.
 - 4) Details of mounting brackets for isolator.
 - 5) Weight distribution for each isolator.
 - 6) Details of seismic snubbers.
 - 7) Code number assigned to each isolator.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Vibration Isolation:
 - a. Except for packaged equipment with integral isolators, single manufacturer will select and furnish isolation required.
 - b. Deflections indicated will be minimum actual static deflections for specific equipment supported.
 - c. Isolator Stability:
 - 1) Size springs of sufficient diameter to maintain stability of equipment being supported with minimum horizontal to vertical stiffness ratio not less than 1:1. Spring diameters will be not less than 0.8 of the compressed height at rated load.
 - 2) Springs will have minimum additional travel to solid equal to 50 percent of the rated deflection.

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- 3) Springs will support 200 percent of rated load when fully compressed without deformation or failure.
- d. Maximum Allowable Vibration Levels: Peak vibration velocities not to exceed 0.08 in/sec. correct equipment operating at vibration velocities that exceed this criteria.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Vibration Isolation:
 1. Amber-Booth.
 2. California Dynamics Corporation.
 3. Mason Industries, Inc.
 4. Kinetics Noise Control.
 5. Vibro-Acoustics.
 6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
 7. Or approved equivalent.

2.2 VIBRATION ISOLATION

- A. Type 1 - Neoprene Pad: Rubber or neoprene waffle pads, single layer, 5/16-inch thick with pattern repeating on 1/2-inch centers; 40 to 50 durometer hardness; maximum loading 50 PSI, 1/4-inch thick steel load distribution plate. Mason Type SWM.
- B. Type 2 - Neoprene Mount: Double-deflection type, with steel or ductile-iron housing containing two separate and opposing, oil-resistant rubber or neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Minimum static deflection of 0.20-inches. Mason Type BR.
- C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators, factory drilled for bolting to structure, if needed, and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside, mounts with leveling bolts. Mason Type SLFH or Type SLF.
- D. Type 4 - Spring with Restraints: Laterally stable, open-spring isolators, factory drilled for bolting to structure and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside; mounts with leveling bolts; steel or cast iron housing for directional seismic snubbing with resilient vertical-limit stops. Mason Type SLR or SSLFH.
- E. Type 5 - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression; designed for 30-degree angular movement before hanger-rod misalignment without binding; seismic rebound washer; 1-inch minimum deflection. Mason Type PC30N.
- F. Seismic Snubbers: Directional interlocking steel members restrained by one-piece molded neoprene bushing, minimum of 3/4-inch thick with minimum 1/8-inch air gap in all directions, capable of withstanding 3 times the rated load capacity. Mason Type Z-1225.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturers written instructions and certified submittal data.

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2. Set floor-mounted equipment on minimum 4-inch-high concrete housekeeping pads. Extend pad at least 6-inches beyond footprint of equipment in each direction.
3. Provide mounts for equipment installed outdoors for wind loads of 30-pounds psf applied to any exposed surface of isolated equipment.
4. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.
5. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances will isolation efficiency be destroyed when bolting the isolators to floor.
6. Building Penetrations: Isolate water piping penetrating wall, ceilings, floors or shafts from the structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe at equipment room wall.
7. Pipe Hangers in Equipment Rooms: Support water and gas piping connected to rotating equipment within equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment are to have a minimum of 1/2 static deflection of equipment isolators. Other isolators should have a minimum of 1/4 static deflection of equipment isolators.

3.2 VIBRATION ISOLATION EQUIPMENT INSTALLATION

- A. Install isolation as indicated on Drawings by type and location and where indicated below.
- B. Isolation Mounts:
 1. Position vibration isolation hanger elements as high as possible in hanger rod assembly but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
 2. Where parallel running pipes are hung together on a trapeze which is isolated from the building, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in the same trapeze.
 3. Install Type 3 and 4 isolators such that installed and operating heights of vibration isolated equipment is identical. Install limit stops so that they are out of contact during normal operation.
 4. Adjust leveling bolts and hanger rod bolts so isolated equipment is level and in proper alignment with connecting pipes.
- C. Isolating Pipe Hangers:
 1. Install on compressed air and water piping connected to rotating equipment in the mechanical rooms. Provide isolating hanger supports for each piece of isolated equipment outside of mechanical rooms and where indicated.
 2. Isolated equipment items include base mounted pumps and line mounted pumps.
- D. Pump Inertia Bases:
 1. Fill with concrete to provide base weight equal to 2 times combined pump, motor, pipe, and water weight.
 2. Provide a minimum operating clearance of 1-inch between structural steel frames and concrete housekeeping pads or floor beneath equipment.
 3. Support heels of suction and discharge elbows from base.
 4. Secure pump and heel supports with inserts and grout.
- E. Other Inertia Bases: Unless otherwise indicated, provide a minimum operating clearance of 1-inch between structural steel frames and the concrete housekeeping pad or floor beneath equipment. Position isolator mounting brackets so that the required clearance is maintained.
- F. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalign shafts or bearings.

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VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

- G. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturers written instructions and certified submittal data.
- H. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances will isolation efficiency be destroyed when bolting the isolators to floor.
- I. Anchorage: Adequately anchor or brace plumbing equipment and piping to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators, pumps and the like.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Plastic Nameplates
 - 2. Tags
 - 3. Plastic Pipe Markers

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, submit Valve Schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals. Provide schedules organized as follows:
 - 1. Equipment Type:
 - a. Identification:
 - b. Background:
 - 1) Size:
 - 2) Color:
 - c. Lettering:
 - 1) Size:
 - 2) Color:

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22, Plumbing Sections. Where more than a single type is specified for application, provide single selection for each product category.
- B. Plastic Nameplates:
 - 1. Brady Corporation
 - 2. Or approved equivalent.
- C. Tags:
 - 1. Brady Corporation
 - 2. Brimar
 - 3. Champion America Inc.
 - 4. Craftmark
 - 5. Seton Identification Products
 - 6. Or approved equivalent.
- D. Plastic Pipe Markers:
 - 1. Brady Corporation
 - 2. Brimar
 - 3. Champion America Inc.
 - 4. Craftmark
 - 5. Seton Identification Products
 - 6. Or approved equivalent.

2.2 PLASTIC NAMEPLATES

- A. Description: Engraving stock melamine plastic laminate 1/8-inch thick, engraved with engraver's standard letter style of the sizes and wording indicated.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/2 inch.
 - 3. Background Color: Black.
 - 4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
 - 5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
 - 6. Signage for hot water outlets on 140 degree F hot water systems not protected by ASSE 1070 mixing valves; hose bibbs, janitor sinks, and fixtures used by trained personnel.
 - a. Manufacturer's standard 1/8-inch thick engraved plastic laminate signage 4 by 4-inches.
 - b. Letter Color: Red.
 - c. Letter Height: 1/2 inch.
 - d. Background Color: White.
 - e. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.3 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2-inch diameter.
- B. Metal Tags: Polished Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

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- C. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
- D. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- E. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
- F. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4- by 7-inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

2.4 PLASTIC PIPE MARKERS

- A. Color: Conform to ASME A13.1 and ANSI Z535.1.
- B. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Lettering and Graphics:
 - 1. General: Coordinate names, abbreviations and other designations used in plumbing identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
 - 2. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).
- B. Preparation: Degrease and clean surfaces to receive adhesive for identification materials.
- C. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- D. Install valve schedule at each mechanical room.
- E. Access Doors: Provide markers on each access door and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions.

3.2 PLASTIC NAMEPLATES

- A. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.
- B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- C. Install plastic nameplates with corrosive-resistant mechanical fasteners.

3.3 TAGS

- A. Small devices, such as in-line pumps, may be identified with tags. Use metal tags on piping 3/4-inch diameter and smaller.
- B. Identify valves in main and branch piping with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.
- C. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.
- D. Tag balancing valves with balanced GPM or CFM indicated after balancing is completed and accepted.
- E. Install tags with corrosion resistant chain.

3.4 PLASTIC PIPE MARKERS

- A. Install plastic pipe markers in accordance with manufacturer's instructions.
- B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- C. For exterior underground piping installations, install underground plastic pipe markers with tracer wire 6- to 8-inches below finished grade directly above buried pipe.
- D. Identify piping, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

END OF SECTION

**SECTION 22 07 00
PLUMBING INSULATION**

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Type 1, Glass Wool Pipe Insulation
 - 2. Type 2, Flexible Elastomeric Insulation
 - 3. Type 5, Glass Wool Equipment Insulation
 - 4. Type 7, ADA Accessible Lavatory/Sink Insulation Kit
 - 5. Accessories
 - 6. Pipe Fitting Insulation Covers

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Piping insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Installer qualifications.
 - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
 - 3. 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.
 - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
 - 5. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.
- B. In addition, meet the following:
 - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
 - 2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
 - 3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
 - 4. Installer to have minimum 5 years' experience in the business of installing insulation.

**SECTION 22 07 00
PLUMBING INSULATION**

- 1.6 WARRANTY
- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- 1.7 FIRE HAZARD CLASSIFICATION
- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with requirements of current edition of UL "Pipe and Equipment Coverings."

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
- A. Type 1, Glass Wool Pipe Insulation:
1. Johns Manville
 2. Knauf
 3. Owens-Corning
 4. Or approved equivalent.
- B. Type 2, Flexible Elastomeric Insulation:
1. Insulation:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
 2. Glue:
 - a. Armacell LLC Armaflex Low VOC Adhesive
 - b. K-Flex
 - c. Or approved equivalent.
 3. Paint:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
- C. Type 5, Glass Wool Equipment Insulation:
1. Knauf
 2. Owens-Corning
 3. Johns Manville
 4. Or approved equivalent.
- D. Type 7, ADA Accessible Lavatory/Sink Insulation Kit:
1. IPS/Truebro
 2. McGuire/Pro-Wrap
 3. Plumberex/Pro-Extreme
 4. Brocar Trap Wrap
 5. Or approved equivalent.
- E. Accessories:
1. ITW Insulation Systems
 2. Or approved equivalent.
- F. Pipe Fitting Insulation Covers:
1. Zeston Johns Manville
 2. ITW Insulation Systems
 3. Or approved equivalent.
- 2.2 TYPE 1, GLASS WOOL PIPE INSULATION
- A. Glass Fiber: ASTM C547 Type I and IV; rigid molded, noncombustible.

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1. Thermal Conductivity Value: 0.27 BTU*in/(hr*sf°F) at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.
3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

2.3 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION

- A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 1. Thermal Conductivity Value: 0.25 BTU*in/(hr*sf°F) at 75 degrees F.
 2. Maximum Service Temperature of 220 degrees F.
 3. Maximum Flame Spread: 25.
 4. Maximum Smoke Developed: 50 (3/4-inch thick and below).
 5. Connection: Waterproof vapor retarder adhesive as needed.
 6. UV Protection: UV outdoor protective coating per manufacturer's requirements.
- B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.
- C. Paint: Nonhardening high elasticity type, specifically manufactured as a protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

2.4 TYPE 5, GLASS WOOL EQUIPMENT INSULATION

- A. Flexible Glass Wool Blanket: ASTM C612; flexible.
 1. Thermal Conductivity Value: 0.24 BTU*in/(hr*sf°F) at 75 degrees F.
 2. Maximum Service Temperature: 450 degrees F.

2.5 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT

- A. P-traps, trap arms, tail pieces, hot water and cold water insulating guards meeting ASTM C1822. Molded closed cell insulation with vinyl cover and nylon fasteners, paintable. Provide accessories as required for complete installation covering all exposed waste piping, water piping, stops and supplies. Color white.

2.6 ACCESSORIES

- A. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- B. Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have same flame and smoke component ratings as insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.7 PIPE FITTING INSULATION COVERS

- A. PVC Plastic Fitting Covers: Schuller Zeston 2000, Knauf Proto Fitting or approved equivalent. One-piece molded type fitting covers and jacketing material, gloss white. Connections: Tacks; pressure sensitive color matching vinyl tape.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION INFORMATION

- A. Verification of Conditions:
 1. Do not apply insulation until pressure testing and inspection of piping has been completed.

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2. Examine areas and conditions under which insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Preparation: Clean and dry surfaces to be insulated.
- C. Installation:
1. Insulation: Continuous through walls, floors, and partitions except where noted otherwise.
 2. Piping and Equipment:
 - a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
- D. Provide accessories as required. See Part 2 Article "Accessories" above.
- E. Protection and Replacement: Protect installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- F. Labeling and Marking: Provide labels, arrows and color coding on piping. Attach labels and flow direction arrows to jacketing per Section 22 05 53, Identification for Plumbing Piping and Equipment.
- G. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 1-1/2-inches and larger (hot and cold piping).
- H. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Pipe Size	Insulation Thickness
Hot Water Piping Above Grade (105F to 140F)	1	Runouts =<1-1/4-inch (uncirculated branches located in partitions within conditioned spaces)	1-inch
		Mains =<1-1/4-inch	1-inch
		Mains >1-1/4-inch	1-1/2-inch
Hot Water Circulation Piping Above Grade (105F to 140F)	1	Mains =<1-1/4-inch	1-inch
		Mains >1-1/4-inch	1-1/2-inch
Cold Water Piping Above Grade	1	=<1-1/2-inch	1/2-inch
		>1-1/2-inch	1-inch
Water Piping Exposed to Weather	1, 2, 4	All	1-1/2-inch
Piping with Heat Tracing	1, 2, 4	Same as circulated hot water based on pipe size and service temperature.	

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ADA Accessible Lavatory/Sink	7	All	As Listed
Condensate Drain Piping	1, 2	All	1/2-inch
Aboveground Refrigerated Water Systems	1, 2	All	1-inch

3.2 TYPE 1, GLASS WOOL PIPE INSULATION

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions for below grade installation.
- C. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.
- D. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.

3.3 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions for below grade installation.
- C. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.
- D. Flexible Elastomeric Tubing: Slip insulation over piping or if piping is already installed, it should be slit and snapped over piping. Joints and butt ends must be adhered with 520 adhesive.

3.4 TYPE 5, GLASS WOOL EQUIPMENT INSULATION

- A. See General Installation Requirements above.
- B. Apply insulation and accessories to roof drain underbodies per manufacturer's recommendations.
- C. Roof Drain/Overflow Drain Underbodies: Cover underside of drain body with glass wool insulation; attached with adhesive and supported externally with 26 gauge galvanized flat strapping anchored to structure.
- D. Storage Tanks: Cover with glass wool, 2-inches thick. Finish with canvas jacket and adhesive. Overlap joints minimum of 4-inches. Apply two coats latex paint; color selected by Architect.

3.5 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.
- C. Provide lavatory/sink insulation kit. Install on waste fittings, hot and cold water stops and supplies.

3.6 ACCESSORIES

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.
- C. Furnish and install accessories for all insulation types listed in this Section.

3.7 PIPE FITTING INSULATION COVERS

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.

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END OF SECTION

**SECTION 22 10 00
PLUMBING PIPING**

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Sanitary, Drainage DWV Piping, Buried Within 5-feet of Building
 - 2. Sanitary, Drainage DWV Piping, Above Grade
 - 3. Water Piping, Buried Within 5-feet of Building
 - 4. Hot and Cold Domestic Water Above Grade
 - 5. Condensate Piping
 - 6. Primer Piping
 - 7. Piping Specialties
 - 8. Cleanouts

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G.
 - 2. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
 - 3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
 - 4. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.
 - 5. Manufacturer's Standards Society (MSS) for valving and support reference standard.
 - 6. American Water Works Association (AWWA) for Valving Assembly Standards.
 - 7. American Society of Sanitation Engineers (ASSE) for Valving Standards.
 - 8. American National Standards Institute (ANSI) for Piping Standards.
 - 9. NFPA Standard 51B - "Fire Prevention in Use of Cutting and Welding Processes."
 - 10. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSA B1375, or DIN 16892 and 16893.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. See component manufacturers listed in individual articles below.
- B. ADS
- C. American-USA
- D. Cerro
- E. Charlotte
- F. Clamp-All
- G. Conbraco/Apollo Press
- H. Elkhart
- I. Enfield
- J. Gruvlok
- K. Husky
- L. Ideal
- M. Mifab
- N. Mission
- O. Mueller
- P. Nibco
- Q. Orion
- R. Shurjoint Mechanical Couplings
- S. Sioux Chief
- T. Spears
- U. Tyler
- V. Uponor
- W. Zurn
- X. Or approved equivalent.
- Y. Cleanouts:
 - 1. J.R. Smith
 - 2. Mifab
 - 3. Sioux Chief
 - 4. Wade
 - 5. Watts
 - 6. Zurn
 - 7. Or approved equivalent.
- Z. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
 - 1. Hilti
 - 2. Proset
 - 3. Or approved equivalent.

2.2 GENERAL

- A. Provide pipe, tube, and fittings of the same type, fitting requirements, grade, class, and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.
- B. Manufactured materials delivered, new to the project site and stored in their original containers.
- C. Product Marking: Furnish each item with legible markings indicating name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

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2.3 SANITARY, DRAINAGE DWV PIPING, BURIED WITHIN 5-FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Heavy Duty: ASTM C1540, Clamp-All Hi-Torq 125, Husky SD 4000, Mifab QXHUB, Mission HeavyWeight couplings.
 - b. Mechanical joint coupling for hubless pipe and fittings is to consist of an elastomeric sealing sleeve and a metallic shield that comply with CISPI 310, ASTM C or ASTM C1540. The elastomeric sealing sleeve is to conform to ASTM C564 or CSA B602 and is to be provided with a center stop. Mechanical joint couplings are to be installed in accordance with the manufacturer's instructions.
- B. PVC Pipe: ASTM D 2665 IPS Schedule 40, **SOLID WALL** piping for drainage/waste and vent (DWV).
 - 1. Fittings: PVC DWV ASTM D2665.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement, 2-step glue (primer and glue) is required.

2.4 SANITARY, DRAINAGE DWV PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Standard Duty: ASTM C1277 or CISPI 310.
- B. PVC Pipe: ASTM D 2665 IPS Schedule 40, **SOLID WALL** piping for drainage/waste and vent (DWV).
 - 1. Fittings: PVC DWV ASTM D2665.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement, 2-step glue (clear primer and glue) is required.

2.5 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING

- A. Copper Pipe: ASTM B88, hard drawn, Type K (A).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: Brazed - BCuP2.
- B. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: Ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, rubber gasket with 3/4-inch diameter rods, mega lug type.

2.6 HOT AND COLD DOMESTIC WATER ABOVE GRADE

- A. Copper Tube: 3-inches and above. ASTM B88 (ASTM BA88m), Type K (A), Drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Brazed BCuP2.
- B. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18 copper.
 - 2. Joints: ASTM B32, alloy Sn95 solder.

2.7 CONDENSATE PIPING

- A. Copper Tube: ASTM B 88 (ASTM B898M), Type K (A), L (B), or M (C).
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.
- B. Use chemical resistant piping for drainage of condensate from combustion fuel sources (such as condensing boilers and water heaters), as noted in this Section for area of

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application.

- C. CPVC (Chlorinated Polyvinyl Chloride) Pipe and Fittings - Except Exterior of the Building and in Plenums and Rated Assemblies:
 - 1. Pipe and Fittings: Schedule 40, NSF-14, ASTM 439, IAPMO IS20-96, socket fittings, solvent weld.

2.8 PRIMER PIPING

- A. Above Ground: Type L hard-drawn copper tubing with wrought sweat fittings and soldered joints.
- B. Below Ground: Type L soft annealed copper tubing with wrought sweat fittings and brazed joints.
- C. Below Ground: Cross-linked polyethylene (PEX) and engineered plastic fittings.

2.9 PIPING SPECIALTIES

- A. Pipe Escutcheons:
 - 1. Provide pipe escutcheons as specified with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas.
 - 2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged.
 - 3. Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged.
- B. Low Pressure Y-Type Pipeline Strainers:
 - 1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 percent of the working pressure of piping system with Type 304 stainless steel screens made with 1/16-inch perforations on 4-inch and smaller strainers, and 1/8-inch perforations on 6-inch and larger strainers.
 - 2. Threaded Ends, 2-inch and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with plug.
 - 3. Flanged Ends, 2-1/2-inch and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with hose bibb.
- C. Air Vent with Valves:
 - 1. Install automatic air vents in all closed and open-loop water systems at high points and at any other point necessary to free system of air. Provide shut-off valve in riser to each automatic vent valve to facilitate servicing. Manual type vent may be used in lieu of automatic type, where specifically shown on the Drawings.
 - 2. Manufacturer: Hoffman #79.
- D. Dielectric Waterways:
 - 1. Provide standard products recommended by manufacturers in service indicated, which effectively isolate ferrous from non-ferrous piping (eliminating electrical conductance) to prevent galvanic action and stop corrosion.
 - 2. Provide dielectric waterways or brass nipple fitting for transitions between dissimilar metal piping.
- E. Unions:
 - 1. Unions to comply with the following schedule:
 - a. Black Steel, 2-inch and smaller: 150 PSI screwed malleable iron, ground joint, brass to iron seat.
 - b. Black Steel, 2-1/2-inch and larger: 150 PSI cast iron screwed flanged, flat faced, full faced gasket.

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- c. Soldered Copper or Brass Pipe, 2-inch and smaller: 150 PSI cast bronzed or copper, ground joint, non-ferrous seat with soldered ends.
 - d. Screwed Copper or Brass Pipe, 2-inch and smaller: 150 PSI cast brass, ground joint, brass to brass seat, threaded ends.
 - e. Flanged Copper or Brass Pipe, 2-1/2-inch and larger: Two 150 PSI cast bronze flanges.
 - f. Manufacturer: EPCO, Mueller, Stanley G. Flagg, Watts, or approved equivalent.
- F. Flexible Piping Connectors - Expansion Loops or Seismic Joints:
- 1. Provide flexible expansion loops of size and material noted on Drawings. Design flexible loops to impart no thrust loads on the anchors. The loop consists of two flexible sections of hose and braid, two 90 degree elbows, and a 180 degree return. Install loops in a neutral, precompressed, or pre-extended condition as required for the application. Provide drain plug for loops installed hanging down. Loops installed straight up may be fitted with an automatic air release valve to purge air from the high point of the loop. Loops installed in any position other than hanging down must have the 180 degree return supported.
 - 2. Copper Pipe: Copper fittings, bronze hose and braid sweat solder ends, Metraloop Series MLS 8000.
 - 3. Steel Pipe: Schedule 40 carbon steel fittings, stainless steel hose and braid.
 - 4. Threaded Ends: Metraloop Series MLT 80000.
 - 5. Flanged Ends: Metraloop Series MLF 80000.
 - 6. Welded Ends: Metraloop Series MLW 80000.
 - 7. Grooved Ends: Metraloop Series MLG 80000.
 - 8. Gas Lines, CSA Approved: Metraloop - Gas MLT or MLF Series.
 - 9. Provide expansion joints by Mason, Flexionics, or Shur Fit, for vertical and horizontal straight run hot water and domestic hot water recirculation piping exceeding 1,000-feet. Install per manufacturer's installation directions.

2.10 CLEANOUTS

- A. Locate cleanouts as shown on Drawings and as required by local code. Cleanouts same size as pipe except that greater than 4-inches will not be required. Plastic components not allowed, except unless specifically noted.
- B. Types:
 - 1. Tile Floor Cleanouts: J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread, ABS plug and standard screws.
 - 2. Carpeted Floor Cleanout: J. R. Smith 4020-X with carpet clamping frame, round heavy-duty nickel bronze top, taper thread, ABS plug, carpet clamping device and standard screws.
 - 3. Concrete Floor Cleanout (General): J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
 - 4. Wall Cleanout: J. R. Smith 4472-U, countersunk bronze taper thread plug, stainless steel shallow cover and vandalproof screws.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Underground Piping Systems:
 - 1. Examination: Verify that excavations are to required grade, dry, and not over-excavated.
 - 2. Perform necessary excavation and backfill required for installation of plumbing work. Repair piping or other work at no expense to Owner.
 - 3. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand,

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- crushed rock or other approved material at no expense to Owner.
4. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of testing laboratory.
 5. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (muck, peat), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native excavation material. Adequate width of trench for proper installation of piping or conduit.
 6. Support Foundations:
 - a. Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Specification Sections or Drawings.
 - b. Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.
 - c. Foundation Material: Where native material has been removed, place and compact necessary foundation material to form base for replacement of required thickness of bedding material.

	Class A		Class B	
Material Passing	Min.	Max.	Min.	Max.
3/4-inch Square Opening	27	47	0	1

- d. Bedding Material: Full bed piping on sand, pea gravel, or 3/4-inch minus crushed rock. Place minimum 4-inch deep layer of sand, pea gravel, or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide firm foundation.
7. Backfilling:
 - a. Following installation and successful completion of required tests, backfill piping in lifts.
 - 1) In "Pipe Zone" place backfill material and compact in lifts not to exceed 6-inches in depth to height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.
 - 2) Place and compact backfill above "Pipe Zone" in layers not to exceed 12-inches in depth.
 - b. Backfill Material:
 - 1) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.
 - 2) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."
8. Compaction of Trench Backfill:
 - a. Where compaction of trench backfill material is required, use one of following methods or combination thereof:
 - 1) Mechanical tamper,

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- 2) Vibratory compactor, or
 - 3) Other approved methods appropriate to conditions encountered.
 - b. Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.
- B. General Installation:
- 1. Work performed by experienced journeyman plumbers. No exceptions.
 - 2. Provide access panels for concealed valves, shock arrestors, trap primers and the like.
 - 3. Install pipes and pipe fittings in accordance with recognized industry practices and manufacturer's recommendations.
 - 4. Align piping accurately at connections, within 3/32-inch misalignment tolerance. Comply with ANSI B31 Code for Pressure Piping.
 - 5. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.
 - a. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.
 - b. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24-inches horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.
 - c. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.
 - d. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.
 - e. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.
 - f. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by contractor at completion; such items to remain Contractor property.
 - g. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Install mating flange faces true and parallel to each other and not requiring springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.

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- h. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.
 - i. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to, or greater than, the maximum working pressure of the system.
 - j. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.
 - k. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.
- C. Testing:
- 1. General:
 - a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) is installed and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and time.
 - b. Notify Architect and local Plumbing Inspector 2 days before tests.
 - c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
 - d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
 - e. Send test results to Architect for review and approval and include in Operation and Maintenance Manual.
 - 2. Testing of Pressurized Systems:
 - a. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 - b. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
 - 3. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Corrosive Soil Conditions:
- 1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's recommendations.
 - 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
 - 3. Obtain and review project soils report for verification of requirements concerning corrosive soils.
- E. Protection:
- 1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after

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- installation. Restore to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.
- F. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
 - 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
 - G. Cut piping squarely, free of rough edges and reamed to full bore. Insert piping fully into fittings.
 - H. Provide joints of type indicated in each piping system.
 - I. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
 - J. Sleeves:
 - 1. Pipe Sleeves:
 - a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.
 - b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with non-shrinking grout or approved caulking compound (except DWV Piping penetrating a concrete slab set on finish grade), provide modular link sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements
 - c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.
 - d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
 - 2. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 - a. Install fabricated pipe sleeve.
 - b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification.
 - c. Seal each end airtight with a resilient nonhardening seal per code.
 - 3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:
 - a. Select and install pre-engineered pipe penetration system in accordance with UL listing and manufacturer's recommendation.
 - b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.

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3.2 SANITARY, DRAINAGE DWV PIPING, BURIED WITHIN 5-FEET OF BUILDING

- A. Excavation and Backfill:
 - 1. See General Installation Requirements above.
- B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- C. Corrosive Soil Conditions:
 - 1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's requirements.
 - 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
- D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.
- E. Sanitary Drainage:
 - 1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.
 - 2. Drains:
 - a. Install drains to suit finished floor. Install drains and components per manufacturer's instructions. Slope flooring to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
 - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
- F. Epoxy Coated Cast Iron Pipe and Fittings: Coat the piping terminus of any cut piping with an applied epoxy per manufacturer's instructions. Denso Protal 7200 fast-cure epoxy repair coating.

3.3 SANITARY, DRAINAGE DWV PIPING, ABOVE GRADE

- A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- B. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
 - 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- C. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.
- E. Sanitary and Storm Drainage:
 - 1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.

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2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60-inches.
3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00, Plumbing Fixtures.
4. Drains:
 - a. Install drains to suit finished floor or roof surface. Install drains and components per manufacturer's instructions. Slope flooring to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
 - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
5. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

3.4 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING

- A. Excavation and Backfill:
 1. See General Installation Requirements above.
- B. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- C. Domestic Water:
 1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
 2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
 3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
 4. Use unions for piping connections to equipment.
 5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
 6. Use reducers or increasers. Use no bushings.
 7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
 8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
 9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
 10. Make ferrous to non-ferrous connections with dielectric fittings.
 11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
 12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
 13. Provide drain valves at base of risers and at low points on the system.
 14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.

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- D. Sterilization of Domestic Water System:
1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
 2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
 3. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.
 4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.
- 3.5 HOT AND COLD DOMESTIC WATER ABOVE GRADE
- A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- B. Testing of Pressurized Systems:
1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
- C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- F. Braze copper tube and fitting socket with BCuP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet is to be visible around the completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCuP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.
- G. Domestic Water:
1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
 2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
 3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
 4. Use unions for piping connections to equipment.
 5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
 6. Use reducers or increasers. Use no bushings.

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7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
 8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
 9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
 10. Make ferrous to non-ferrous connections with dielectric fittings.
 11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
 12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
 13. Provide drain valves at base of risers and at low points on the system.
 14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.
- H. Sterilization of Domestic Water System:
1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
 2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
 3. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.
 4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

3.6 CONDENSATE PIPING

- A. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

3.7 PRIMER PIPING

- A. Excavation and Backfill:
1. See General Installation Requirements above.
- B. Testing:
1. See General Installation Requirements above.

3.8 PIPING SPECIALTIES

- A. Excavation and Backfill:
1. See General Installation Requirements above.
- B. Drainage, Waste, and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- C. Corrosive Soil Conditions:
1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's requirements.

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- 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
- D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

3.9 **CLEANOUTS**

- A. Install in aboveground piping and building drain piping as indicated, as required by code; at each change in direction of piping greater than 135 degrees; at minimum intervals of 100-feet; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping. Select type to match adjacent building finish. Provide shop drawings to Architect to coordinate locations and types of cleanouts with Architect prior to installation.

END OF SECTION

**SECTION 22 30 00
PLUMBING EQUIPMENT**

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Commercial High Efficiency Storage Type Gas Water Heaters
 - 2. Domestic Expansion Tanks ASME
 - 3. Domestic Circulation Pumps - Close-Coupled, In-Line
 - 4. Domestic Circulation Pump with Adaptive Variable Speed Drive

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Seismic anchor details and calculations signed and stamped by licensed Oregon structural engineer with equipment data.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G compliant.
 - 2. ISO 9001 Certified.
 - 3. IAPMO Low Lead Certification.
- C. Products approved for installation by state authorizing agency, no exceptions.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Commercial High Efficiency Storage Type Gas Water Heaters:
 - 1. Bradford White Series eF
 - 2. A.O. Smith BTH
 - 3. LAARS UHE
 - 4. State SUF
 - 5. Rheem/Ruud
 - 6. Or approved equivalent.
- B. Domestic Expansion Tanks ASME:
 - 1. Bell and Gossett Series
 - 2. American Wheatley

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3. Amtrol
 4. Armstrong
 5. Watts
 6. Hansen
 7. Or approved equivalent.
- C. Domestic Circulation Pumps - Close-Coupled, In-Line:
1. Bell and Gossett Series
 2. Armstrong
 3. Grundfos
 4. Paco
 5. Taco
 6. Or approved equivalent.
- D. Domestic Circulation Pump with Adaptive Variable Speed Drive:
1. Goulds Series
 2. Grundfos
 3. Armstrong
 4. Taco
 5. Or approved equivalent.

2.2 GENERAL

- A. Reference Drawings for capacities and specific model numbers.

2.3 COMMERCIAL HIGH EFFICIENCY STORAGE TYPE GAS WATER HEATERS

- A. System: Domestic Hot Water.
- B. Provide two gas fired storage high efficiency (98 percent) water heaters with capacities as indicated on Contract Documents. System to deliver minimum 120 degrees F hot water to tenants.
- C. Water Heaters in accordance with certified UL volume III tests and most current edition of ASHRAE 90.1. Maximum supply gas pressure to heater 13.8 inches WC (0.5 PSI).
- D. Water Heaters factory provided with an CSA (AGA) electronic intermittent gas ignition, gas pressure regulator and pilot filter, coated steel burners, draft diverter and flue damper; 120 volt, 60 Hz, single phase electrical connection.
- E. Water Heaters factory provided with 2 3/4-inches by 3 3/4-inches hand hole cleanout listed by Underwriters Laboratories. Controls include, upper and lower thermostats, combination temperature and pressure gauge, low water, CSA (AGA) and ASME rated temperature and pressure relief valve, and draft regulator. Control compartment door to be hinged for easy access. Heater(s) to be equipped with multiple anodes for cathodic protection.
- F. Water Heaters to be insulated with vermin-proof glass fiber insulation, R 16 Value minimum. Outer jacket to have a baked enamel finish over a bonderized undercoating.
- G. Internal surfaces of water heaters exposed to water to be glass-lined with alkaline borosilicate, nickelous oxide composition that has been fused to steel by firing at temperature range of 1400 degrees F to 1600 degrees F.
- H. Coordinate exact location of units and electrical characteristics with Division 26, Electrical work.
- I. Provide seismic anchor calculations for this equipment, stamped and signed by licensed Oregon structural engineer.
- J. Warranty: Three year unconditional tank replacement, one year on parts and devices.

2.4 DOMESTIC EXPANSION TANKS ASME

- A. System: Domestic water.
- B. Welded steel, constructed, tested and stamped in accordance with ASME Boiler and Pressure Vessel Code for working pressure of 125 PSI. Support floor mounted tanks with steel legs or base. Provide single flexible diaphragm securely sealed into tank to separate air charge from system water, to maintain design expansion capacity. Provide

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pressure gauge and air-charging fitting, and drain fitting. Diaphragm: Removable and replaceable in line.

2.5 DOMESTIC CIRCULATION PUMPS - CLOSE-COUPLED, IN-LINE

- A. System: Domestic water
- B. Description: Factory-assembled and tested, single-stage, close-coupled, in-line, seal-less centrifugal pump.
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
 - 2. Casing: Bronze/stainless steel, with threaded companion-flange connections.
 - 3. Impeller: Corrosion-resistant material.
 - 4. Motor: Non-overloading at any point on pump curve, Single speed, unless otherwise indicated. Comply with requirements in Division 22 Section "Common Motor Requirements."
- C. Capacities and Characteristics as per Drawings.
- D. See detail on Drawings for pump controls.

2.6 DOMESTIC CIRCULATION PUMP WITH ADAPTIVE VARIABLE SPEED DRIVE

- A. The pump is to be listed for domestic hot water systems and is to comply with lead free (less than or equal to 0.25 percent) products in potable/drinking water systems.
- B. Pump is to be of the in-line wet rotor design.
- C. The pump is to be a standard product of a single pump manufacturer.
- D. The enclosure to be marked "Enclosure Type 2."
- E. The pump to be certified and listed by a Nationally Recognized Test Laboratory (NRTL) for U.S. and Canada to comply with:
 - 1. UL778
 - 2. UL 60730-1A
 - 3. CAN/CSA No. 108
- F. The pump is to be labeled on the nameplate as having an Energy Efficiency Index (EEI) of no greater than 0.20.
- G. Ratings:
 - 1. Maximum Pressure: 175 PSIG
 - 2. Minimum Media Temperature: 14 degrees F
 - 3. Maximum Media Temperature: 230 degrees F
 - 4. Maximum Continuous Media Temperature: 203 degrees F
 - 5. Maximum Sound Pressure Level: 43dB(A)
 - 6. Voltage tolerance: [1x115V +/-10 percent][1x208-230V +/-10 percent]
 - 7. Maximum Energy Efficiency Index: 0.20
- H. Pump Construction:
 - 1. Pump housing: Cast Iron: EN-JGL-250 with surface treatment; Stainless Steel: 304 Stainless Composite.
 - 2. Impellers: PES 30-percent GF or stainless steel.
 - 3. Rotor Can: PPS: PPS reinforced with Carbon Fiber(Fortran MT9141L GF40)
 - 4. Rotor Cladding: 316 Stainless Steel
 - 5. Stator Housing: Aluminum
 - 6. Shaft: 316L Stainless Steel
 - 7. Thrust Bearing: Axial: Carbon Graphite, Radial: ceramic Alumina Hilox 961
 - 8. O-Rings: EPDM
 - 9. Bearing Plate: 304 Stainless Steel
 - 10. Neck Ring: 304 Stainless Steel
 - 11. Control Box: Polycarbonate
- I. Motor:
 - 1. Motor to be 4-pole permanent-magnet (PM motor) and tested with the pump as one unit.

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2. Each motor is to be of the integrated Variable Speed Drive design consisting of a motor and a Variable Frequency Drive (VFD) built and tested as one unit.
 3. The Motor to be self-ventilating.
 4. Minimum insulation class for the motor to be Class F.
 5. The integrated VFD control is to utilize an energy optimization algorithm to minimize energy consumption by reducing the factory-set setpoint and adjust to system characteristics.
- J. Operating Modes:
1. The pump is to have the following control mode and operating modes:
 - a. Proportional Pressure - The head delivered is to be reduced from a manual setpoint linearly in accordance with decrease in flow demand in the system
 - b. Constant Pressure - A manual set, constant head is maintained, irrespective of flow up to the maximum speed of the pump.
 - c. Constant Curve - The pump runs as an uncontrolled pump by the means of a set of pump curves. The pump curve adjustable between maximum and minimum from the control panel or through a wireless remote control.
 - d. Constant Temperature - The pump is to adjust speed to maintain a constant media temperature in the flow pipe in which the pump is installed.
 - e. Constant Differential Temperature - The pump is to adjust speed to maintain a constant temperature drop between the flow pipe in which the pump is installed and a user installed temperature sensor.
- K. Interface and Communication:
1. The pump is to have an integrated operator interface consisting of:
 - a. Minimum 2.4-inch (measured diagonally) color TFT display.
 - 1) Push buttons for navigation of menu.
 - 2) Push Buttons must be able to operate at minimum 25,000 times.
 - 3) LEDs to signal pump status for quick indication.
 2. The pump is to have a sensor integrated directly into the pump housing with 4 lines consisting of Ground, Supply, and two signals for Differential Pressure and Media Temperature.
 3. The pump module is to have one analog input configurable for either 4-20mA or 0-10VDC input signal configurable for external Temperature or Pressure sensor, or Setpoint influence.
 4. The pump module is to have two Output Relays. Each relay to be configurable for Alarm, Reading, or Operating indication.
 5. Is to be capable of accepting an optional add-on module for integration into Building Management Systems:
 - a. LonWorks
 - 1) BACnet
 - 2) Modbus
 - 3) Profibus

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

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- C. Orients so controls and devices needing service and maintenance have adequate access.
- D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
- E. Connect water piping to units with shutoff valves and unions.
- F. Equipment Rigging: Heavy duty rigging eye bolts for Crosby Group swivel hoist rings installed over pump access covers for removal or maintenance.
- G. Equipment Start-Up:
 - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
 - 2. Start-up performed by authorized manufacturer's representative or agent. Provide credentials of start-up personnel to Architect and Owner's Authorized Representative for approval.
 - 3. Remove and replace filters when start-up testing is executed.
 - 4. Manufacturer adjusts operating parameters of equipment to compensate to elevation of 500-feet above sea level.
 - 5. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
 - 6. Provide written report from manufacturer's representative on results of start-up within 48 hours.
 - 7. Technical Training of maintenance staff includes two hours minimum per each piece of equipment.
 - 8. Seismic Verification:
 - a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
 - b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

3.2 **COMMERCIAL HIGH EFFICIENCY STORAGE TYPE GAS WATER HEATERS**

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- C. Orients so controls and devices needing service and maintenance have adequate access.
- D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
- E. Connect water piping to units with shutoff valves and unions.
- F. Equipment Start-Up:
 - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
 - 2. Start-up performed by authorized manufacturer's representative or agent. Provide credentials of start-up personnel to Architect and Owner's Authorized Representative for approval.
 - 3. Remove and replace filters when start-up testing is executed.
 - 4. Manufacturer adjusts operating parameters of equipment to compensate to elevation of 500-feet above sea level.
 - 5. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
 - 6. Provide written report from manufacturer's representative on results of start-up within 48 hours.
 - 7. Technical Training of maintenance staff includes two hours minimum per each piece of equipment.

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8. Seismic Verification:
 - a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
 - b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

3.3 DOMESTIC EXPANSION TANKS ASME

- A. Precharge tank per manufacturers recommendation.
- B. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- C. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- D. Orients so controls and devices needing service and maintenance have adequate access.
- E. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
- F. Connect water piping to units with shutoff valves and unions.

3.4 DOMESTIC CIRCULATION PUMPS - CLOSE-COUPLED, IN-LINE

- A. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Orients so controls and devices needing service and maintenance have adequate access.
- C. Connect water piping to units with shutoff valves and unions.
- D. Provide lift check valves 5 diameters downstream of pump discharge for circulating pumps piped in a parallel configuration.
- E. Equipment Start-Up:
 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
 2. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
 3. Seismic Verification:
 - a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
 - b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

3.5 DOMESTIC CIRCULATION PUMP WITH ADAPTIVE VARIABLE SPEED DRIVE

- A. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Orients so controls and devices needing service and maintenance have adequate access.
- C. Connect water piping to units with shutoff valves and unions.
- D. Equipment Start-Up:
 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
 2. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
 3. Seismic Verification:

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PLUMBING EQUIPMENT

- a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
- b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

END OF SECTION

**SECTION 22 40 00
PLUMBING FIXTURES**

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Plumbing Fixtures:
 - a. China Fixtures, White Only
 - b. Enameled Steel Fixtures, White Only
 - c. Faucet Fittings
 - d. Fiberglass Fixtures, White Only
 - e. Molded Resin or Stone Fixtures
 - f. Shower Valves
 - g. Stainless Steel Fixtures
 - h. Thermostatic Mixing Valves
 - i. Trench Drains
 - 2. Carriers
 - 3. Catch Basins
 - 4. Drinking Fountains
 - 5. Electric Water Coolers
 - 6. Fixture Trim
 - 7. Floor Drains
 - 8. Floor Sinks
 - 9. Flushometers - Water Closet/Urinal
 - 10. Hose Bibbs
 - 11. Hub Drains
 - 12. Water Closet Seats
 - 13. Drain Boxes
 - 14. Water Supply Boxes
 - 15. Stainless Steel Drainage Fittings

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Comply with lead free (less than or equal to 0.25 percent) products in drinking water systems.
 - 2. NSF 61, Annex G, Drinking Water System Components, Compliant.
 - 3. ISO 9001, Quality Management Standard Certified.
 - 4. IAPMO Low Lead Certification.

**SECTION 22 40 00
PLUMBING FIXTURES**

5. Provide fixtures, faucets and accessories to meet barrier free requirements of the governing code with respect to plumbing fixtures provided for the physically handicapped.
6. Items approved for use by State of Oregon.

1.6 **WARRANTY**

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

- A. "Or approved equivalent" as defined in 22 00 00, Plumbing Basic Requirements. Substitution process requirements apply to approved equivalent products.
- B. General Plumbing Fixtures: See Schedule on Drawings for type.
 1. China Fixtures - White Only:
 - a. American Standard
 - b. Briggs
 - c. Kohler
 - d. Or approved equivalent.
 2. Enameled Steel Fixtures - White Only:
 - a. American Standard
 - b. Briggs
 - c. Crane
 - d. Eljer
 - e. Kohler
 - f. Universal-Rundle
 - g. Or approved equivalent.
 3. Faucet Fittings:
 - a. Public:
 - 1) American Standard
 - 2) Chicago
 - 3) Delta Commercial
 - 4) Moen Commercial
 - 5) Sloan
 - 6) Symmons
 - 7) T & S Brass
 - 8) Or approved equivalent.
 4. Fiberglass Fixtures - White Only:
 - a. Aqua-Glass
 - b. Briggs
 - c. Crane
 - d. Comfort Designs
 - e. Florestone
 - f. Hytec
 - g. Mustee
 - h. Universal-Rundle
 - i. Or approved equivalent.
 5. Molded Resin or Stone Fixtures:
 - a. Fiat
 - b. Mustee
 - c. Stern Williams
 - d. Or approved equivalent.
 6. Shower Valves:

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PLUMBING FIXTURES**

- a. Acorn
- b. Chicago
- c. Delta
- d. Moen
- e. Powers
- f. Symmons
- g. Or approved equivalent.
- 7. Stainless Steel Fixtures:
 - a. Acorn Engineering
 - b. Haws
 - c. Zurn Elkay
 - d. Or approved equivalent.
- 8. Thermostatic Mixing Valves:
 - a. Bradley
 - b. Caleffi
 - c. Holby
 - d. Powers
 - e. Symmons
 - f. Or approved equivalent.
- 9. Trench Drains:
 - a. Channel-Slope
 - b. JR Smith
 - c. Mifab
 - d. PolyDrain
 - e. Polycast
 - f. Quazite
 - g. Zurn
 - h. Or approved equivalent.
- C. Carriers:
 - 1. JR Smith
 - 2. Mifab
 - 3. Zurn
 - 4. Or approved equivalent.
- D. Catch Basins:
 - 1. Lynch
 - 2. Or approved equivalent.
- E. Drinking Fountain:
 - 1. Elkay
 - 2. Halsey-Taylor
 - 3. Haws
 - 4. Murdock
 - 5. Oasis
 - 6. Sunroc
 - 7. Or approved equivalent.
- F. Electric Water Coolers:
 - 1. Elkay
 - 2. Halsey-Taylor
 - 3. Haws
 - 4. Murdock
 - 5. Oasis
 - 6. Sunroc
 - 7. Or approved equivalent.
- G. Fixture Trim:
 - 1. McGuire
 - 2. Dearborn Brass
 - 3. Oatey

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PLUMBING FIXTURES**

- 4. Or approved equivalent.
- H. Floor Drains:
 - 1. Mifab
 - 2. Sioux Chief
 - 3. Smith
 - 4. Wade
 - 5. Watts
 - 6. Zurn
- I. Floor Sinks:
 - 1. Commercial Enameling
 - 2. Mifab
 - 3. Sioux Chief
 - 4. Smith
 - 5. Wade
 - 6. Watts
 - 7. Zurn
 - 8. Or approved equivalent.
- J. Flushometers - Water Closet/Urinal:
 - 1. Delaney
 - 2. Sloan
 - 3. Zurn
 - 4. Or approved equivalent.
- K. Hose Bibbs:
 - 1. Chicago
 - 2. JR Smith
 - 3. Mifab
 - 4. Wade
 - 5. Woodford
 - 6. Zurn
 - 7. Or approved equivalent.
- L. Hub Drains:
 - 1. JR Smith
 - 2. Mifab
 - 3. Zurn
 - 4. Or approved equivalent.
- M. Water Closet Seats:
 - 1. Bemis
 - 2. Or approved equivalent.
- N. Drain Boxes:
 - 1. Sioux Chief
 - 2. Or approved equivalent.
- O. Water Supply Boxes:
 - 1. Sioux Chief
 - 2. Or approved equivalent.
- P. Stainless Steel Drainage Fittings:
 - 1. Blucher
 - 2. Josam
 - 3. JR Smith
 - 4. Kusel
 - 5. Mifab
 - 6. Zurn
 - 7. Or approved equivalent.

SECTION 22 40 00
PLUMBING FIXTURES

2.2 GENERAL PLUMBING FIXTURES

- A. Review substitution request requirements in Division 01, General Requirements and 22 00 00, Plumbing General Requirements.
- B. Reference Architectural Details for mounting height and location of fixtures.
- C. Provide factory fabricated fixtures of type, style and material indicated on the plumbing fixture connection schedule shown on the Drawings. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by manufacturer, or required for complete installation. Where more than one type is indicated, selection is installer's option; but, fixtures of same type must be furnished by a single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.
- D. Provide fixtures complete with fittings, supports, fastening devices, bolt caps, faucets, valves, traps, stops and appurtenances.
- E. Plumbing Fixture Thermostatic Mixing Valves:
 - 1. Lavatories provide ASSE 1070 compliant mixing valves or multiple lavatories served by a single ASSE 1070 compliant mixing valve.
 - 2. Sinks serviced with a single ASSE 1070 mixing valve or multiple sinks served by a single ASSE 1070 mixing valve.
 - 3. Commercial kitchen handsinks provide ASSE 1070 mixing valves.
 - 4. Janitor sinks or process/maintenance type sinks do not require ASSE 1070 mixing valves if operated by trained personnel. Provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.
 - 5. Hot water hose bibbs do not require ASSE 1070 mixing valves if operated by trained personnel. Provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

2.3 CARRIERS

- A. Wall Hung Water Closets:
 - 1. Vertical: Zurn Z-1204-N4-X-50 or Z-1204-ND4-X-50 (JR Smith 230y-M54-M12 or 230DY-M54-M12). Adjustable vertical load siphon jet with 500 lb. capacity.
 - 2. Horizontal: Zurn ZE-1203-N4-X-50 or ZE-1203-ND4-X-50 (JR Smith 220 R or L-Y-M54-M12 or 220DY-M54-M12). Adjustable horizontal siphon jet with 500 lb. load capacity.
- B. Wall Hung Urinal: Zurn Z-1218-WS or Z-1222-WS. (JR Smith 637). Coupling type or plate type with bearing plate 200 lb. capacity.
- C. Wall Hung Lavatory: Zurn Z-1231 (D). (JR Smith 700). Concealed arm or Plate type, 250 lb. capacity.
- D. Wall Hung Service Sink: Zurn Z-1218. (JR Smith 913/914). Coupling type. 300 lb. capacity.
- E. Wall Hung Drinking Fountain: Zurn Z-1225-BL (JR Smith 834-97-98). Plate type. 300 lb. capacity.

2.4 CATCH BASINS

- A. See Schedule on Drawings for type.

2.5 DRINKING FOUNTAINS

- A. See Schedule on Drawings for type.

2.6 ELECTRIC WATER COOLERS

- A. See Schedule on Drawings for type.

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PLUMBING FIXTURES**

2.7 FIXTURE TRIM

- A. Traps: Provide heavy duty commercial grade traps on fixtures except fixtures with integral traps. Exposed traps will be chromium plated cast brass or 17 gauge chromium plated brass tubing.
 - 1. Sink: McGuire 8912CDF.
 - 2. Lavatory: McGuire 8902CDF.
- B. Supplies and Stops: Lead free heavy duty commercial grade, chrome plated with brass stems. Stops: T-handle or Loose Key type.
 - 1. Lavatory: McGuire LFH2165LK.
 - 2. Sink: McGuire LFH2167LK.
 - 3. Water Closets: McGuire.
- C. Lavatory Grid Strainer: McGuire 155A.
- D. Sink Grid Strainer: McGuire 152N.
- E. Shower Grid Strainer: McGuire 1266.
- F. Sink Basket Strainer: McGuire 151.
- G. Trim barrier-free wrap for P-traps and supplies by McGuire, Pro-Wrap, Plumberex or Truebro.
- H. Escutcheons: McGuire wrought brass deep bell.
- I. Wax Rings and Toilet Bolts: WM Harvey No Seep No. 1 053065-N.

2.8 FLOOR DRAINS

- A. See Schedule on Drawings for types.

2.9 FLOOR SINKS

- A. See Schedule on Drawings for types.
- B. Plastic components are not allowed.

2.10 FLUSHOMETERS - WATER CLOSET/URINAL

- A. See Schedule on Drawings for types.

2.11 HOSE BIBBS

- A. See Schedule on Drawings for types.

2.12 HUB DRAINS

- A. See Schedule on Drawings for type.

2.13 WATER CLOSET SEATS

- A. See Schedule on Drawings for type.

2.14 DRAIN BOXES

- A. See Schedule on Drawings for type.
- B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

2.15 WATER SUPPLY BOXES

- A. See Schedule on Drawings for type.
- B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

2.16 STAINLESS STEEL DRAINAGE FITTINGS

- A. Austenitic Stainless Steel of Material type (304/316) and gauge as listed in the plumbing fixture schedule.

SECTION 22 40 00
PLUMBING FIXTURES

PART 3 - EXECUTION

3.1 GENERAL PLUMBING FIXTURE INSTALLATION INFORMATION

- A. Verification of Conditions:
1. Examine rough-in work of water supply and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures.
 2. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.
 3. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings and pertinent codes and regulations, design and referenced standards.
 4. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
 5. Install a stop valve in a readily accessible location in water connection to each fixture.
 6. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
 7. Seal fixtures to walls and floors using silicone sealant Dow Corning No. 780 or approved equivalent. Match sealant color to fixture color.
 8. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
 9. Inspect each unit for damage prior to installation. Replace damaged fixtures.
 10. Replace washers or cartridges of leaking or dripping faucets and stops.
 11. Clean fixtures, trim and strainers using manufacturer's recommended cleaning methods and materials.
 12. During construction, cover installed fixtures, drains, sinks and water coolers with cardboard and wrap with sheet plastic.
 13. Provide trap primers for floor drains, floor sinks, trench drains and hub drains.
 14. Do not use lead flashing.
- B. Owner Furnished Equipment:
1. Rough-in and make final connections to Owner furnished equipment. Provide necessary items to complete installation.
 2. Comply with requirements of this Section and Drawings for installation procedures.
- C. Adjusting and Cleaning: Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation. Adjust water pressure at drinking fountains, faucets, shower valves and flush valves to provide proper flow stream and specified GPM. Repair leaks at faucets and stops.
- D. Extra Stock: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner.
- E. Field Quality Control: Upon completion of installation of plumbing fixtures, test fixtures to demonstrate capability and compliance with Specifications. Correct or replace malfunctioning units at site, then retest to demonstrate compliance.
- F. Protection: Protect fixtures and equipment from damage. Cover finished fixtures with cardboard and sheet plastic. Fixtures are not to be used during construction. Replace damaged items with new.
- G. Signage: For fixtures that do not have ASSE 1070 mixing valve protection for hot water temperature, provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

**SECTION 22 40 00
PLUMBING FIXTURES**

- 3.2 CARRIERS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
 - C. Coordinate wall thickness so carrier has adequate depth to be concealed.

- 3.3 CATCH BASINS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb and level.
 - C. Backfill with 3/4-inch crushed rock and compact.

- 3.4 DRINKING FOUNTAINS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.5 ELECTRIC WATER COOLERS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.6 FIXTURE TRIM INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.7 FLOOR DRAINS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.8 FLOOR SINKS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid. Set fixture rim/grate flush with surrounding finish surface unless specifically noted otherwise.

- 3.9 FLUSHOMETERS - WATER CLOSET/URINAL INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.10 HOSE BIBBS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.11 HUB DRAINS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

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PLUMBING FIXTURES**

- 3.12 WATER CLOSET SEATS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.13 DRAIN BOXES INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.14 WATER SUPPLY BOXES INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.15 STAINLESS STEEL DRAINAGE FITTINGS
 - A. Install components in accordance with manufacturers instructions and approved product data submittals.
 - B. Set plumb, level and flush to surrounding surfaces unless specifically noted otherwise.
 - C. As applicable install clamping devices-flanges to receive surface finish products (flooring, membranes etc.).

END OF SECTION

SECTION 23 00 00
HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

SECTION 23 00 00 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 DESIGN-BUILD SUMMARY

- A. Work included in 23 00 00 applies to Division 23, Heating, Ventilating and Air Conditioning (HVAC) work to provide materials, labor, tools, permits and incidentals to make HVAC systems ready for Owner's use for proposed project.

1.2 DESIGN-BUILD INSTRUCTIONS

- A. This document is issued to give Bidders a basis for preparing a proposal to design and install complete HVAC systems for this project.
- B. Alternates to this Document may be offered as a separate proposal.
- C. Bidder to submit the following information with the Proposal:
 - 1. Preliminary drawings indicating major equipment locations and preliminary layout.
 - 2. Description of systems, manufacturer and method of control.
 - 3. List of materials proposed for systems which are applicable to this project.
 - 4. Any other information which the bidder considers pertinent in evaluating the proposal.

1.3 DESIGN-BUILD APPROACH

- A. Use this Specification for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.
- B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by Authority Having Jurisdiction (AHJ).
- C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.4 DESIGN-BUILD CRITERIA/CALCULATIONS

- A. Related Work Specified Elsewhere: Contents of Section apply to Division 23 Specifications. Requirements of Section are a minimum for Division 23 Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.
- B. Systems Overview:
 - 1. No alteration of the existing heating equipment is expected.
 - 2. Provide new split system gas-fired heat pump with cooling to serve the new Classroom space.
 - 3. Provide new heater and exhaust fan for Turnout Dry Room. Fan and heater are to be controlled with a timer switch. Avoid routing ductwork on mezzanine.
 - 4. Provide new exhaust system for renovated locker room and restroom area.
 - 5. Provide new High Volume Low Speed ceiling fan for open warehouse area. New HVLS fan should be similar to existing.
 - 6. Provide venting for cloths dryer, terminate via sidewall with wall cap.
 - 7. Provide unit heater for new Apparatus Bay. Provide intake and exhaust for new Apparatus Bay to control CO and CO2 levels in the space.
- C. Design Criteria:
 - 1. HVAC System: Constant air volume split system gas heating/electric cooling units. Provide supply and return air ductwork. Mount diffusers/grilles in ceiling grid. Maximum duct velocity to be 1100 FPM. See Architectural Drawings for tenant spaces.
 - a. Cooling Temperatures:

SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

- 1) 74 Degrees F DB, 63 Degrees F WB Inside Design
 - 2) 95 Degrees F DB, 67 Degrees F WB Outside Design
 - b. Heating Temperatures:
 - 1) 70 Degrees F DB Inside Design
 - 2) 10 Degrees F DB Outside Design
 - c. Lighting: 1.6 w/sf (this exceeds w/sf requirements of energy code to allow to install luminaires which are exempt from calculation requirements.)
 - d. Miscellaneous Electrical Load: 2 w/sf.
 - e. Acoustical Requirements: Sound generated by HVAC system in occupied zone of a treated space not-to-exceed noise criterion of NC-35.
 - f. Provide exhaust systems to toilet and shower areas. The exhaust systems provide a minimum of 10 air changes per hour.
 - g. Provide exhaust system from dryers. Coordinate exact size of exhaust duct with installed dryer manufacturer requirements. Coordinate exhaust discharge location to maintain minimum separation distance of 10 feet-0 inches to any operable windows or mechanical air intake locations.
 - h. Provide drawings with duct layout, exhaust fans, A/C units, size, and description of equipment, heating/cooling load calculations, equipment selections, etc. for review and for permit process. Coordinate ceiling diffuser locations with Architectural Drawings and Lighting Plan.
 - i. Outside air ventilation to be designed per current state ventilation code or ASHRAE recommendations, whichever is greater.
 - j. Provide calculations and installation details of equipment mounting to structure to conform to local seismic codes. Calculations and details to be included on Drawings as a part of submittal process.
 - k. Provide equipment and/or devices for pressure control of spaces so as not to over pressurize space.
2. Air Distribution Duct System:
 - a. Provide ductwork, including collars, register boxes, fire dampers, fire/smoke dampers, exhaust fans, ventilation louvers, roof vents and screens, as well as dampers and other miscellaneous items not specifically mentioned but necessary for a complete installation. Apply latest Standards of SMACNA and/or ASHRAE with respect to sheet metal gauge and general construction for round and rectangular ducts.
- D. Calculations:
1. Submit heating and cooling load calculations per ASHRAE Standards for each HVAC zone.
 2. Submit natural gas sizing calculations.
 3. Submit structural calculations for seismic bracing of HVAC equipment and piping. Structural calculations to be signed by a Registered Engineer in the State of Oregon.

1.5 SECTION INCLUDES

- A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 1. Provide: To furnish and install, complete and ready for intended use.

SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.6 RELATED SECTIONS

- A. Contents of Section applies to Division 23, HVAC Contract Documents.
- B. Related Work:
 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.7 REFERENCES AND STANDARDS

- A. References and Standards per Division 01, General Requirements, individual Division 23, HVAC Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 1. State of Oregon:
 - a. OAR - Oregon Administrative Rules
 - b. 2023 OESC - Oregon Electrical Specialty Code
 - c. 2022 OFC - Oregon Fire Code
 - d. 2022 OMSC - Oregon Mechanical Specialty Code
 - e. 2023 OPSC - Oregon Plumbing Specialty Code
 - f. 2022 OSSC - Oregon Structural Specialty Code
 - g. 2021 OEESC - Oregon Energy Efficiency Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act
 2. ABMA - American Bearing Manufacturers Association
 3. ADA - Americans with Disabilities Act
 4. AHRI - Air-Conditioning Heating & Refrigeration Institute
 5. AMCA - Air Movement and Control Association
 6. ANSI - American National Standards Institute
 7. ASCE - American Society of Civil Engineers
 8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
 9. ASHRAE Guideline 0, The Commissioning Process
 10. ASME - American Society of Mechanical Engineers

SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

11. ASPE - American Society of Plumbing Engineers
 12. ASSE - American Society of Sanitary Engineering
 13. ASTM - ASTM International
 14. AWWA - American Water Works Association
 15. CFR - Code of Federal Regulations
 16. CGA - Compressed Gas Association
 17. CISPI - Cast Iron Soil Pipe Institute
 18. EPA - Environmental Protection Agency
 19. ETL - Electrical Testing Laboratories
 20. FM - FM Global
 21. GAMA - Gas Appliance Manufacturers Association
 22. HI - Hydraulic Institute Standards
 23. IAPMO - International Association of Plumbing & Mechanical Officials
 24. IFGC - International Fuel Gas Code
 25. ISO - International Organization for Standardization
 26. MSS - Manufacturers Standardization Society
 27. NEC - National Electric Code
 28. NEMA - National Electrical Manufacturers Association
 29. NFPA - National Fire Protection Association
 30. NFGC - National Fuel Gas Code
 31. NRCA - National Roofing Contractors Association
 32. NSF - National Sanitation Foundation
 33. OSHA - Occupational Safety and Health Administration
 34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
 35. TEMA - Tubular Exchanger Manufacturers Association
 36. TIMA - Thermal Insulation Manufacturers Association
 37. UL - Underwriters Laboratories, Inc.
- D. See Division 23, HVAC individual Sections for additional references.

1.8 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23, HVAC Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail or posted to ftp site and be native/searchable PDF format. Scanned copies are not acceptable. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
 3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23, HVAC Sections.

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4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.
 - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - d. For vibration isolation of equipment, list make and model selected with operating load and deflection.
 - e. See Division 23, HVAC individual Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-16 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
7. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
8. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
9. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties proposing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any

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- product marked "or approved equivalent," a substitution request must be submitted to Engineer for approval prior to bid.
10. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.
 - a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.
 11. Samples: Provide samples when requested by individual Sections.
 12. Resubmission Requirements:
 - a. Make corrections or changes in submittals as required in response to Engineer's comments. Provide a cover letter with resubmittal that includes responses to each of the Engineer's submittal review comments and identifies changes in the resubmittal. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates "no exception taken" or "make corrections noted."
 - 2) When submitting drawings for Engineer's re-review, clearly indicate changes on drawings and cloud any revisions. Submit a list describing each change.
 13. Operation and Maintenance Manuals, Owner's Instructions:
 - a. Submit, at one time, electronic files (native/searchable PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include Warranty per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Sections.
 - 4) Include product certificates of warranties and guarantees.
 - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 6) Include copy of startup and test reports specific to each piece of equipment.
 - 7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.
 - 8) Include commissioning reports.
 - 9) Include copy of valve charts/schedules.
 - 10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews;

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Contractor to bear costs for additional reviews at Engineer's hourly rates.

- b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration."
 - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
14. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit Model and drawings upon substantial completion.
 - d. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.
 - e. See Division 23, HVAC individual Sections for additional items to include in record drawings.

1.9 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

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- D. Manufacturer's Instructions: Follow manufacturers' written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.10 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, equipment, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.

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- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 23, HVAC Sections. In absence of specific requirements in Division 01, General Requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Milcor, Elmdor, Acudor or approved equivalent.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- D. Earthwork:

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1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
 - E. Firestopping:
 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - F. Pipe Installation:
 1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
 2. Include provisions for servicing and removal of equipment without dismantling piping.
 - G. Plenums:
 1. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect/Engineer of any discrepancy.
 - H. Provide miscellaneous supports/metals required for installation of equipment, piping, and ductwork.
- 3.2 SEISMIC CONTROL
- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 23 HVAC Sections.
 - B. General:
 1. Earthquake resistant designs for HVAC (Division 23) equipment and distribution, i.e. motors, ductwork, piping, equipment, etc. to conform to regulations of jurisdiction having authority.
 2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to

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- withstand a force in direction equal to value defined by jurisdiction having authority.
 - 3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
 - 4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
 - C. Piping and Ductwork:
 - 1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
 - D. Provide means to prohibit excessive motion of mechanical equipment during earthquake.
- 3.3 REVIEW AND OBSERVATION
- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
 - B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground system installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. After major equipment is installed.
 - 5. When main systems, or portions of, are being tested and ready for inspection by AHJ.
 - C. Final Punch:
 - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the mechanical systems are ready for final punch.
 - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility To Be Determined
- 3.4 CONTINUITY OF SERVICE
- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping and ductwork, and wiring to point of connection. Where existing systems are being utilized, clean existing distribution systems (ductwork, piping, fans, air handlers) prior to connecting new ductwork or piping.
 - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 - 4. Organize work to minimize duration of power interruption.
- 3.5 CUTTING AND PATCHING
- A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific

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requirements, comply with individual Division 23, HVAC Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftspeople of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.
- B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar items until in service.

3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division

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01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 START UP

- A. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.

3.11 PAINTING

- A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 2. After acceptance by Authority Having Jurisdiction (AHJ), In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 3. See individual equipment Specifications for other painting.
 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 5. Piping and Ductwork: Clean, primer coat and paint exposed piping and ductwork on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. Coordinate locations/sizes of access panels with Architect prior to work.

3.13 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. Scope:

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- a. It is the intent of these documents to provide necessary information and adjustments to the HVAC system required to meet code, and accommodate installation of new work.
 - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
 3. Unless specifically indicated on Drawings, remove exposed, unused ductwork and piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
 4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing and Balancing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document
 - h. Commissioning Reports

3.15 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Tests:
 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.
 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.16 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation

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and Maintenance Manuals.

3.17 ELECTRICAL INTERLOCKS

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.18 TEMPORARY HEATING, COOLING AND HUMIDITY CONTROL

A. Provide temporary heating, cooling, controls, humidification and dehumidification as required to facilitate the construction of the project. Size and select temporary system based on the requirements of the various trades during construction. This includes, but is not limited to, drywall, case work, wood flooring and wood finishes that are subject to warping. Size and install system to prevent mold growth. Coordinate the location of the temporary system. The house system can be used. Develop a procedure for how the house system will be used including a sketch depicting the house system, how filtration will be used to prevent construction debris from entering the system and how often the filters will be changed, how the ductwork will be cleaned after use to ensure a clean system is turned over to the Owner and how the units are sized. Submit this procedure to the Mechanical Engineer for review. Follow National Air Duct Cleaners Association (NADCA) duct cleaning procedures and guidelines. Warranties for the house system, if new, to commence when the Owner moves in if house system is used as the means to maintain the climate within the building during construction. Include this warranty requirement in the original bid or proposal amount. Coordinate and provide any temporary power, controls, ductwork, piping, plumbing anchorage, miscellaneous steel and structural supports required to support the temporary system. Installation of the system to comply with all applicable codes and be acceptable to the Authority Having Jurisdiction (AHJ).

END OF SECTION

**SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Starters
 - 2. Shaft Grounding
 - 3. Motors

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NEMA Premium Efficiency
 - 2. Energy Policy Act (EPACT), latest applicable version(s) for minimum motor efficiencies.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.
 - 2. Electrical components and materials to be UL and ETL listed/labeled as suitable for location and use.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. For motors 50 HP and larger, provide 5-year manufacturer's limited warranty from date of substantial completion.

PART 2 - PRODUCTS

2.1 STARTERS

- A. Manufacturers
 - 1. Cerus
 - 2. Eaton Electrical
 - 3. General Electric
 - 4. Siemens
 - 5. Schneider Electric/Square D
- B. Single Phase Motors:

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1. Manual across-the-line starting switch having toggle-operated switch pilot running light and built-in thermal overload device with heating element rated not more than 115 percent motor full load current indicated on name plate of motor to be protected. Surface mount starters. Provide NEMA-1 enclosure.
2. Overload relays to be melting alloy type with a replaceable control circuit module. Thermal units to be interchangeable. Starter to be non operative if thermal unit is removed.
3. Single-phase motors with automatic controls. Provide motor-rated relay with coils rated for control voltage.
- C. Starters up to Size 8 to be suitable for the addition of a minimum of three external auxiliary contacts (normally open or normally closed). Contactor, coils, and relays to perform the control functions of the associated equipment and control sequence.
- D. Three Phase Motors up to and Including 15 HP:
 1. Provide enclosed type magnetic across-the-line starter with thermal overload and undervoltage protection.
 2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.
 3. Starters for 3-phase motors to have overload protection in each of the three legs, with external manual reset.
 4. Unless indicated on Drawings or in Specifications, furnish motor starters with a neon pilot light. Neon lights are required for exhaust fan switches.
 5. Equip starters with integral transformer and coil for control circuit. Coordinate coil voltage with control voltage.
- E. For Three Phase Motors Greater than 15 HP:
 1. Provide combination starter and fused safety disconnect integral in the same enclosure. Utilize Type 'RK' or 'L' fuses. Provide fuse block with rejection type fuse holders. Size fuses per motor manufacturer's recommendations.
 2. Provide a solid-state reduced voltage starter, consisting of power section, one-piece removable printed circuit logic board and field wiring interface terminals. Logic board uses quick disconnect plug-in connectors for current transformers inputs, line-and-load voltage inputs, SCR gate firing output circuits and status panel. 3-phase current sensing via current transformers. Class 10 electronic overload protection.
 3. Motor starters to include the following protections:
 - a. Inverse time running overcurrent protection.
 - b. 250 percent to 500 percent current limit adjustment.
 - c. Minimum and maximum voltage adjustments.
 - d. Voltage stability adjustment.
 - e. Single-phase protection with built-in short-time delay.
 - f. Undervoltage protection with built-in short time delay.
 - g. MOV surge suppression protection of SCRs rated 10 percent above the rated voltage.
 - h. Phase sequence protection.
 4. Display: Door-mounted status LCD alphanumeric or LED display indicating run, undervoltage, phase loss, phase current unbalance, overcurrent trip, overtemperature, current limit, end of ramp, and incorrect phase rotation.
 5. Enclosure: NEMA 12. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified, then provide "Hand-Off-Auto" selector switch
 6. Input/Output Relays: Provide relays as required to provide the control sequence.
 7. UL 508 listed.

2.2 SHAFT GROUNDING

- A. Manufacturers
 1. Shaft Grounding Inc.

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2. Aegis SGR Bearing Protection Ring
3. Or approved equivalent.
- B. Variable Speed Motor Shaft Grounding: Shaft grounding ring; solid ring type.
- C. Provide shaft grounding assembly on motors controlled by variable frequency drive. Shaft grounding device to be in the form of brush that resides on the motor shaft. Brush assembly shall be capable of tolerating misalignment and maintaining rotating contact throughout the motors life.
- D. Material: Material used in the grounding assembly shall be stable material commonly used within industry that is not believed to constitute a hazardous material under Occupational Safety & Health Administration (OSHA) regulations.
- E. Brushes: Specifically developed carbon compounds of sustained performance with wear life expectancy of 3 years minimum.
- F. Seals: Sealed type to keep contaminants from entering the shaft grounding system in wet or severe environment applications.
- G. Shaft Grounding Assembly: For clean room air handling systems, use the type that contains the wear products within a special enclosure within the shaft grounding system.

2.3 MOTORS

- A. Manufacturers:
 1. Lincoln Motor
 2. Century Electric Motors (formerly A.O. Smith Electrical Products)
 3. Baldor Electric
 4. General Electric
 5. Toshiba
 6. Exception: Motors integral to equipment efficiency listing (EER, COP, etc.) per listing agency.
- B. Construction:
 1. Open drip-proof type except where specifically noted otherwise.
 2. Design for continuous operation in 40 degrees C environment.
 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 4. Built-in thermal overload protection or externally protected with separate overload with low-voltage release or lock-out. Quick trip device on hermetically sealed motors.
 5. Service Factor: 1.15 for poly-phase motors except 1.25 for motors associated with shaft pressurization system fans and 1.35 for single phase motors.
 6. Efficiency: Provide NEMA Premium Efficiency motors.
 7. Motors used in conjunction with variable speed drives: Variable torque type matched for the full operating range of the variable frequency drive. As a minimum, motors to have Class F insulation, winding insulation rated for 1000 Volts and insulated bearings to prevent high frequency ground path. Loads not-to-exceed 80 percent of nameplate rating
- 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. Coordinate conductor sizes with Division 26, Electrical. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- E. Single Phase Power, Split Phase Motors:
 1. Starting Torque: Less than 150 percent of full load torque.
 2. Starting Current: Up to seven times full load current.
 3. Breakdown Torque: Approximately 200 percent of full load torque.

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4. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
5. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
- F. Single Phase Power, Permanent-Split Capacitor Motors:
 1. Starting Torque: Exceeding one fourth of full load torque.
 2. Starting Current: Up to six times full load current.
 3. Multiple Speed: Through tapped windings.
 4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.
- G. Single Phase Power, Capacitor Start Motors:
 1. Starting Torque: Three times full load torque.
 2. Starting Current: Less than five times full load current.
 3. Pull-up Torque: Up to 350 percent of full load torque.
 4. Breakdown Torque: Approximately 250 percent of full load torque.
 5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
 6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
 7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
- H. Three Phase Power, Squirrel Cage Motors:
 1. Starting Torque: Between 1 and 1-1/2 times full load torque.
 2. Starting Current: Six times full load current.
 3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
 4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
 5. Insulation System: NEMA Class B or better. Use class F insulation when motors are controlled by a VFD.
 6. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
 7. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 8. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.
 9. 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 200,000 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.
 10. Sound Power Levels: To NEMA MG 1.
 11. Weatherproof Epoxy Treated Motors: Epoxy coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
 12. Nominal Efficiency: Meet or exceed NEMA Premium Efficiency rating when tested in accordance with IEEE 112.
 13. Nominal Power Factor: Minimum at full load and rated voltage when tested in accordance with IEEE 112.
- I. Electronically Commutated Motors:
 1. Brushless DC type motor specifically designed for intended application.
 2. Permanently lubricated motor with heavy duty ball bearing type to match intended application load.

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3. Operation Range: 20 percent to 100 percent of full speed (80 percent turndown).
4. Motor Efficiency: Minimum 85 percent efficient at all speeds.
5. Pre-wired to specific voltage and phase. Internal motor circuitry to convert AC power supplied to the fan to DC power.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.
- B. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- C. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.
- D. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency and latest EPACT.
- E. Vertical in-line pump motors per NEMA MG1 vertical motor requirements.
- F. Exception: Motors less than 250 watts, for intermittent service, motors furnished with equipment manufacturer's standard package equipment need not conform to these specifications.
- G. Single phase motors for air compressors and pumps: Capacitor start type.
- H. Motors located in exterior locations or wet air streams are to be of totally enclosed type.
- I. Motors located in outdoor, wet/wash-down locations: Totally enclosed weatherproof epoxy-sealed type. Provide protective covering for electronically commutated motors located in outdoor or wet/wash-down locations.
- J. Disconnects: Provided by Division 26, Electrical unless specified otherwise.
- K. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.2 STARTER INSTALLATION

- A. Install starters in accordance with manufacturer's instructions.
- B. Coordinate disconnect requirements and location with Division 26, Electrical if not integral to starter. If starter is installed out of line of sight of motor, provide additional disconnect at motor per code.
- C. Provide NEMA housing appropriate to installation location.
- D. Provide supports and install securely, in neat and workmanlike manner, as specified in NECA 1.
- E. Meet mounting height and accessible location requirements per local code.
- F. Provide fuses for fusible switches.
- G. Select and install overload heater elements in motor starters to match installed motor characteristics.
- H. Single Phase 120 Volt Starter: If not furnished as single packaged controller/disconnect, provide contactors, relays, wiring and devices necessary to match sequence of operation for equipment.

3.3 SHAFT GROUNDING INSTALLATION

- A. Shaft grounding assembly installation not to affect the motor manufacturer warranty. Where the severe environment conditions require application of the shaft grounding types that are screwed into the motor shaft, the installation of the shaft grounding system performed either by the motor manufacturer or by the motor manufacturer authorized facility.

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- B. Bond the brush to the closest ground point using code sized green insulated stranded copper conductor per manufacturer instructions.
- C. Test and verify the performance of the assembly to ensure that under no conditions the shaft exceeds 3 volts.
- D. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- E. Check line voltage and phase and ensure agreement with nameplate.
- F. Verify motor rotation.

3.4 MOTOR INSTALLATION

- A. Electrical Service: Power wiring from source to motor termination under Division 26, Electrical.
- B. Install in accordance with manufacturer's instructions. Coordinate with starter or variable speed controller with control sequence to provide necessary starter accessories.
- C. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- D. Check line voltage and phase and ensure agreement with nameplate.
- E. Verify motor rotation.
- F. Field Quality Control:
 - 1. Prepare for acceptance tests as follows:
 - a. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - b. Test interlocks and control features for proper operation.
 - c. Verify that current in each phase is within nameplate rating.
 - 2. Testing: Perform the following field quality-control testing:
 - a. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
 - b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - a. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with requirements.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - c. Verify bearing lubrication.
 - d. Verify proper motor rotation.
 - e. Test Reports: Prepare a written report to record the following test procedures used:
 - 1) Test results that comply with requirements.
 - 2) Test results that do not comply with requirements and corrective action taken to achieve compliance.
- G. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.
- H. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Hangers and Supports for HVAC Piping, Ductwork and Equipment
 - 2. Wall and Floor Sleeves
 - 3. Building Attachments
 - 4. Flashing
 - 5. Miscellaneous Metal and Materials

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.
 - 2. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
 - 3. Install ductwork and piping per SMACNA's requirements.
 - 4. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Welding:
 - a. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Welding for Hangers:
 - a. Qualify procedures and personnel according to AWS D9.1, Sheet Metal Welding Code for duct joint and seam welding.
 - 3. Engineering Responsibility:
 - a. Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, duct support, equipment hangers/supports, support from floor structure, roof structure or from structure above, and seismic restraint by a qualified Structural Professional Engineer.
 - 1) Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that

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HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

are similar to those indicated for this Project in material, design, and extent.

4. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
5. Support systems to be supplied by a single manufacturer.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. Provide pipe, ductwork and equipment hangers and supports in accordance with the following:
 1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor is responsible for their design.
 2. Connections to structural framing not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
 1. Support frames such as pipe racks or stanchions for piping, ductwork, and equipment which provide support from below.
 2. Equipment, ductwork and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- E. Provide seismic restraint hangers and supports for piping, ductwork and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hangers and Supports for HVAC Piping, Ductwork and Equipment:
 1. Anvil International
 2. B-Line Systems, Inc.
 3. Erico Company, Inc.
 4. Nelson-Olsen Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Snappitz Thermal Pipe Shield Manufacturing
 7. Unistrut Corporation
- B. Wall and Floor Sleeves:
 1. Thunderline Corporation "Link Seal"
 2. Or approved equivalent.
- C. Building Attachments:
 1. Anchor-It
 2. Gunnebo Fastening Corporation
 3. Hilti Corporation
 4. ITW Ramset/Red Head
 5. Masterset Fastening Systems, Inc.

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HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

- 2.2 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT
- A. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
 - B. Hanger Rod Couplings: Anvil Figure 136, B-Line Figure B3220, or approved equivalent; malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
 - C. Channel Hanging System:
 - 1. Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A1011 Grade 33, one side of channel to have a continuous slot within turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
 - 2. Concrete Inserts: Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
 - D. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
 - E. Pipe Hangers:
 - 1. Pipe Rings for Hanger Rods:
 - a. Pipe Sizes 2-inches and Smaller: Adjustable swivel ring hanger, UL listed. Erico 100 or 101, Anvil Figures 69 or 104, or approved equivalent.
 - b. Pipe Sizes 2-1/2-inches and Larger: Clevis type hangers with adjustable nuts on rod, UL listed. Anvil figure 260, Erico 400, or approved equivalent.
 - c. Pipe hangers to have same finish as hanger rods.
 - F. Pipe Saddles and Shields:
 - 1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 - 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
 - G. Riser Clamps: Steel, UL listed. MSS Type 8. Erico 510 or 511. Copper coated; Erico 368.
 - H. Pipe Slides: Anvil, reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
 - I. Pipe Guides:
 - 1. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Contact with chilled water pipe not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - 2. Furnish and install guides approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.
 - J. Pipe Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.
 - K. Below Ground Pipe Supports:
 - 1. Pipe Hangers All Sizes: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 304. MSS Type 1. Erico 406.
 - 2. Rod: 5/8-inch stainless steel Type 18-8.
 - 3. Eyebolt: Stainless steel Type 18-8.
 - 4. Nuts and Washers: Stainless steel Type 18-8.

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- L. Thermal Hanger Shield Inserts:
 - 1. 100-PSI (690-kPa) minimum compressive strength calcium silicate insulation, encased in sheet metal shield or polyisocyanurate rigid foam exceeding the load bearing weight of the pipe at the hanger point with a PVC vapor barrier.
 - 2. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier or polyisocyanurate rigid foam with a PVC vapor barrier.
 - 3. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate or polyisocyanurate rigid foam with a PVC vapor barrier.
 - 4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 - 6. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
 - 7. Thermal Hanger Shield Insulation Operating Temperature: Meet or exceed fluid temperature in pipe.
- M. Freestanding Roof Supports: Polyethylene high-density UV resistant quick "pipe" block with foam pad.

2.3 WALL AND FLOOR SLEEVES

- A. Below Grade or High Water Table Areas:
 - 1. "Link-Seal" Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal.
 - 2. Provide Type S unless otherwise noted.
- B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
- C. Fabricated Accessories:
 - 1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 - 2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:
 - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
 - b. Sleeve Sizes 5-6-inches: 16 gauge.
 - c. Sleeve Sizes 7-inches and Larger: 14 gauge.
 - d. Fire-Rated Safing Material.
 - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 pounds per cubic foot density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
 - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.4 BUILDING ATTACHMENTS

- A. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- B. Powder-Actuated Drive Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Anchor Bolts:
 - 1. Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer. Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

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2. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
3. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
4. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.

2.5 FLASHING

- A. Steel Flashing: 26 gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

2.6 MISCELLANEOUS METAL AND MATERIALS

- A. General:
 1. Provide miscellaneous supports and metal items, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on drawings or otherwise not shown on drawings that are necessary for completion of the project. Contractor is responsible for their design.
 2. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather. Cold galvanize field-welded joints and components. Use materials compatible with system being supported (i.e. aluminum for aluminum ductwork, stainless steel for stainless steel ductwork).
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support ductwork.
- I. Grout:
 1. ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 2. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 3. Properties: Nonstaining, noncorrosive, and non gaseous.
 4. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

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PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.
- B. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate proper placement of inserts, anchors and other building structural attachments.
- D. Equipment Clearances: Do not route ductwork, equipment, or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-foot lateral clearance from all sides of electric switchgear panels. Do not route ductwork, equipment, or piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact ductwork, equipment or pipe routing to provide proper clearance with such items.

3.2 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

- A. Hang rectangular sheet-metal ducts with a cross sectional area of less than 7 SF with galvanized strips of No. 16 USS gauge steel 1-inch wide, and larger ducts with steel angles and adjustable hanger rods similar to piping hangers. Support at a maximum of 8-feet on center.
- B. Support horizontal ducts within 24-inches of each elbow and within 48-inches of each branch intersection.
- C. Design hangers and supports to allow for expansion and contraction.
- D. Provide aluminum supports for aluminum ductwork.
- E. Provide stainless steel supports for stainless steel ductwork.
- F. Support vertical ducts at maximum intervals of 16-feet and at each floor.
- G. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- H. Install flexible ductwork per the more stringent of SMACNA HVAC Duct Construction Standards or the following:
 - 1. Support horizontal duct runs at not more than 4 feet intervals.
 - 2. Support vertical risers at not more than 6 feet intervals.
 - 3. Limit sag between support hangers to 1/2-inch per foot of spacing support.
 - 4. Supports shall be rigid and shall be not less than 1.5-inches wide at point of contact with the duct surface.
 - 5. Duct bends shall be not less than 1.5 duct diameter bend radius.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Floor supports in mechanical rooms to be elevated 1-inch above finish floor and void space filled with masonry grout.
- K. Anchor ducts securely to building in such a manner as to prevent transmission of vibration to structure. Do not connect duct hanger straps directly to roof deck. Do not support ducts from other ducts, piping or equipment.
- L. Attach strap hangers installed flush with end of sheet-metal duct run to duct with sheet-metal screws.
- M. Construct exterior ductwork or ductwork which is otherwise exposed to weather watertight and slope 1/4-inch per foot to avoid standing water.

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- N. Exposed ductwork hung in clean areas such as sanitary areas, pharmaceutical areas, wash down areas or food process areas to be installed using double end, food grade trapeze hanger rods suitable for use with food grade strut.
- O. Channel Support System Installation:
 - 1. Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - 2. Field assemble and install according to manufacturer's written instructions.
- P. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- Q. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- R. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- S. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping, ductwork and equipment to proper level and elevations.
- T. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.
- U. Horizontal Piping Hangers and Supports; Horizontal and Vertical Piping, and Hanger Rod Attachments:
 - 1. Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems and in accordance with manufacturer's published product information.
 - 2. Use only one type by one manufacturer for each piping service.
 - 3. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping.
 - 4. Pipe support spacing (pipe supported in ceiling or floor-supported) to meet latest applicable Code and manufacturer's requirements.
 - 5. Provide copper-plated hangers and supports for uninsulated copper piping systems.
- V. Plumber's Tape not permitted as pipe hangers or pipe straps.
- W. Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
- X. Pipe Ring Diameters:
 - 1. Uninsulated and Insulated Pipe, Except Where Oversized Pipe Rings are Specified: Ring inner diameter to suit pipe outer diameter.
 - 2. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
- Y. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
- Z. Pipe Support Brackets: Support pipe with pipe slides.
- AA. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.
- BB. Pipe Guides:
 - 1. Install on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Contact with chilled water pipe does not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - 2. Install approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.
- CC. Heavy-Duty Steel Trapeze Installation:
 - 1. Arrange for grouping of parallel runs of horizontal piping and support together on field fabricated, heavy-duty trapezes.

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2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 3. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- DD. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers. Maximum spacings: MSS SP-58.
- EE. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
- FF. Do not support piping from other piping.
- GG. Fire protection piping will be supported independently of other piping.
- HH. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
- II. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
- JJ. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 2. Do not exceed pipe stress limits according to ASME B31.9.
 3. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 4. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields to span arc of 180 degrees.
 5. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 6. Shield Dimensions for Pipe, not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
 - b. NPS 4 (DN100): 12-inches long and 0.06-inch thick.
 - c. NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
 - d. NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
 - e. NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
 7. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
 - a. Insert Material: Length at least as long as protective shield.
 8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- KK. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
- LL. Pipe Curb Assemblies:
1. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.
 2. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.
- MM. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets,

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through below ceiling corridor walls, and through equipment room walls and floors.

- NN. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
 2. Riser clamps to be directly under fitting or welded to pipe.
 - a. Riser to be supported at each floor of penetration.
 - b. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.
- OO. Piping Above Roof:
1. Provide engineered roof piping supports appropriate for installation and attachment to the roof structure or structure below roof (see Architectural and Structural Drawings for roof construction, building structural systems, and sloping requirements for insulation).
 2. Design a complete system unless specific details have been shown on Drawings.
 3. Provide calculations signed and stamped by a Structural Engineer, registered in the State where the project is located at, as part of submittals and coordinated shop drawings.
 4. Do not use freestanding supports unless approved by the Structural Engineer of Record.
 5. Provide miscellaneous metal and materials as specified in Miscellaneous Metal and Materials article, above.

3.3 WALL AND FLOOR SLEEVES

- A. "Link-Seal" Pipe Sleeves: Install at floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.
- B. Fabricated Pipe Sleeves:
1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirements, and by waterproofing requirements.
 2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
 3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
 4. Seal each end airtight with a resilient nonhardening sealer, UL listed, fire rated ASTM 814.
- C. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
1. Install fabricated pipe sleeve.
 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
 3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814.
- D. Piping Penetrations Through Fire-Rated (One to Three Hour) Assemblies:
1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
 2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.

3.4 BUILDING ATTACHMENTS

- A. Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions and in accordance manufacturer's published product information.

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- B. Select size of building attachments to suit hanger rods.
- C. Space attachments within maximum piping span length indicated in MSS SP-58.
- D. Install building attachments within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.
- E. Attachment to Wood Structure: Anvil side beam bracket Figure 202 for attachment to wooden beam or approved attachment for a wood structure.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install concrete inserts before concrete is placed; fasten inserts to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- H. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Test powder-actuated insert attachments with a minimum load of 100 pounds.
- I. Do not use powder-actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4-inches thick.
- J. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.
- K. Anchor Bolts:
 - 1. Install anchor bolts for mechanical equipment, piping and ductwork as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment, piping and ductwork are hung.
 - 2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

3.5 FLASHING

- A. Flash and counterflash where piping, ductwork and equipment passes through weather or waterproofed walls, floors, and roofs.
- B. Provide 12-inch minimum height curbs for roof-mounted mechanical equipment. Flash and counter flash with galvanized steel, soldered and waterproofed.

3.6 MISCELLANEOUS METAL AND MATERIALS

- A. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
- B. Finishes:
 - 1. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized

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- ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
2. Metal in Contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
 3. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.
- C. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
 - D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.
 - E. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete masonry or similar construction.
 - F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
 - G. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
 - H. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
 - I. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
 - J. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
 - K. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
 - L. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
 - M. Provide galvanized components for items exposed to weather.

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- 3.7 FIRE RATED SUPPORTS
- A. Provide fire rated support as required by Codes.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Vibration Isolation
 - 2. Seismic Restraint Devices
 - 3. Factory Finishes
 - 4. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork
- B. General:
 - 1. Vibration isolation for mechanical ductwork, piping and equipment.
 - 2. Seismic restraint for mechanical ductwork, piping and equipment.
 - 3. Seismic Certification for equipment, hangers and systems.
 - 4. Special inspections for systems.
- C. Scope of Work:
 - 1. Vibration isolation and seismic restraint of new equipment and systems within project boundary defined in architectural drawings.
 - 2. Vibration isolation and seismic restraint of new equipment and systems in existing buildings to points of connection with existing systems.
 - 3. Seismic restraint of existing systems and equipment shown on Drawings, within project boundary defined in architectural drawings.
 - 4. Provide supplementary structural steel for seismic restraint systems. No hanging from roof deck is permitted on this project, unless specifically allowed by Structural Engineer of Record in writing prior to bid.

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Vibration Isolation:
 - a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
 - b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
 - 1) Fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads.
 - 2) Equipment mounting holes.
 - 3) Dimensions.
 - 4) Size and location of concrete and steel bases and curbs.
 - 5) Isolation selected for each support point.
 - 6) Details of mounting brackets for isolator.

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- 7) Weight distribution for each isolator.
 - 8) Details of seismic snubbers.
 - 9) Code number assigned to each isolator.
 - c. Design calculations: Provide calculations for selecting vibration isolators and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Seismic Restraint:
 - a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section. Shop drawings to be stamped by a professional Structural Engineer licensed in State of Oregon.
 - b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details and indicate quantity, diameter and depth of penetration of anchors. Calculations certified by professional Structural Engineer licensed in State of Oregon.
4. Seismic Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter and depth of penetration of anchors.
5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y and z planes.
6. Welding certificates.
7. Equipment Certification: Provide seismic certification for equipment as noted in Seismic Design Summary or schedules on Drawings.

1.5 **QUALITY ASSURANCE**

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 1. Vibration Isolation:
 - a. Except for packaged equipment with integral isolators, single manufacturer selects and furnishes isolation required.
 - b. Deflections indicated on drawings are minimum actual static deflections for specific equipment supported.
 - c. Isolator Stability:
 - 1) Size springs of sufficient diameter to maintain stability of equipment being supported. Spring diameters not less than 0.8 of compressed height at rated load.
 - 2) Springs have minimum additional travel to solid equal to 50 percent of rated deflection.
 - 3) Springs support 200 percent of rated load, fully compressed, without deformation or failure.
 - d. Maximum Allowable Vibration Levels: Peak vibration velocities not exceed 0.08 in/sec. Correct equipment operating at vibration velocities that exceed this criteria.
 2. Seismic Restraint:
 - a. Code and Standard Requirements:
 - 1) Seismic restraint of equipment, piping and ductwork to be in accordance with latest enacted version of ASCE 7-16.
 - b. Confirm Seismic Control requirements in Division 01, General Requirements and Structural documents.
 - c. Certification: See Seismic Design Table or schedules on Drawings for equipment, systems and seismic-restraint devices designated to have

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- seismic certification/qualification. Horizontal and vertical load testing and analysis performed according to ASCE 7-16. Anchorage systems to bear anchorage preapproval number from an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing or calculations, if preapproved ratings are not available. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be sealed by qualified licensed professional engineer in State of Oregon. Testing and calculations must include both shear and tensile loads and one test or analysis at 45 degrees to weakest mode.
- d. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure be designed to resist total design seismic force prescribed in local building code:
 - 1) Floor- or roof-mounted equipment weighing 400 pounds or greater.
 - 2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.
 - 3) In-line duct devices connected to ductwork weighing 75 pounds or greater.
 - 4) Housekeeping slabs: provide reinforcement and anchorage to building structure.
 - e. Where required, seismic sway bracing of suspended duct and piping meet following:
 - 1) Pipe and duct runs requiring seismic bracing have minimum of two traverse braces and one longitudinal brace. Longitudinal (or traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.
 - 2) Seismic bracing may not pass through seismic separation joint. Pipe or duct runs that pass through seismic separation joint must be restrained within 5-feet of both sides of separation.
 - 3) Seismic brace assembly spacing not to exceed 40-feet transverse and 80-feet longitudinal.
 - f. Seismic restraints may be omitted from suspended piping and duct if following conditions are satisfied:
 - 1) For piping or ducts supported by rod hangers 12-inches or less in length from top of duct to bottom of structural support. Top connections to structure have swivel joints, eye bolts, or vibration isolation hangers for entire length of system run.
 - 2) Lateral motion of system will not cause damaging impact with surrounding systems or cause loss of system vertical support.
 - 3) System must be welded steel pipe, brazed copper pipe, sheet metal duct or similar ductile material with ductile connections.
- C. Seismic restraints, including anchors to building structure, be designed by registered professional Structural Engineer licensed in State of Oregon. Design includes:
- 1. Number, size, capacity and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both unit to curb and curb to structure.
 - 2. Number, size, capacity and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations and test data verifying horizontal and vertical ratings of seismic restraint devices.
 - 3. Number, size, capacity and location of braces and anchors for suspended piping and ductwork on as-built plan drawings.
 - 4. Maximum seismic loads to be indicated on drawings at each brace location. Drawings bear stamp and signature of registered professional Structural Engineer who designed layout of braces.

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- 1.6 WARRANTY
- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- 1.7 EXTRA MATERIALS
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
- A. Vibration Isolation:
1. The VMC Group
 2. B-Line Systems, Inc.
 3. Kinetics Noise Control, Inc.
 4. Mason Industries, Inc.
 5. M.W. Saussé - Vibrex
 6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
- B. Seismic Restraint Devices:
1. The VMC Group
 2. B-Line Systems, Inc.
 3. Kinetics Noise Control, Inc.
 4. Mason Industries, Inc.
 5. M.W. Saussé - Vibrex
 6. California Dynamics Corporation
 7. Cooper B-Line Tolco
 8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 9. Hilti, Inc.
- C. Factory Finishes:
1. Kynar 500 Fluoropolymer Coating
 2. Or approved equivalent.
- D. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork:
1. The VMC Group
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
 4. Hilti, Inc.
 5. Cooper B-Line, Inc.
 6. California Dynamics Corporation
 7. Unistrut
 8. ISAT, Inc.
 9. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
- 2.2 VIBRATION ISOLATION
- A. Type 1 - Neoprene Pad: Natural rubber waffle pads, arranged in single or multiple layers, 3/4-inch thick per layer with pattern repeating on 1/2-inch centers; 50 durometer hardness; maximum loading 60 PSI. Minimum 1/4-inch thick steel load distribution plate and 1/16-inch shim plates between layers, factory cut to sizes matching requirements of supported equipment. Molded bridge with neoprene anchor bolt bushing and flat washer face to prevent metal to metal contact. Number of layers required for equipment

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- scheduled. Mason Type: Super WMH.
- B. Type 2 - Neoprene Mount: Double-deflection type, with ductile-iron housing containing two separate and opposing, oil-resistant natural rubber or bridge bearing neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Neoprene elements to prevent metal to metal contact during normal operation. Minimum static deflection of 0.30-inches. Mason Type: BR.
- C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 2. Minimum Additional Travel: 50 percent of required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside. Baseplates limit floor load to 100 PSIG (690 kPa).
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
 7. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
 8. Mason Type: SLFH or SLF.
- D. Type 4A - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
1. Housing: Steel with resilient vertical-limit stops (out of contact during normal operation) to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Restraining bolts have large rubber grommets to provide cushioning in vertical and horizontal directions. A minimum clearance of 3/8-inch maintained around restraining bolts so as not to interfere with spring action.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
 7. Mason Type: SLR.
- E. Type 4B - Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint with neoprene acoustical cup, spring inspection ports and rebound adjustment ports.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
 4. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
 5. Mason Type: SSLFH.
- F. Type 5A - Restrained Elastomeric Hangers: Double-deflection type, with molded, oil-resistant natural rubber or bridge bearing neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Seismic rebound steel and bonded LDS rubber washer to limit upward seismic movement. Mason Type: RWHD.

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- G. Type 5B - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Mason Type: 30N.
- H. Type 5C - Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 8. Mason Type: RW30.
- I. Type 6 - Horizontal Thrust Restraints: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
 - 8. Mason Type: WBI or WBD.
- J. Type 7 - Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on isolation material of 500 PSIG (3.45 MPa) and for equal resistance in all directions. Mason Type: ADA.
- K. Type 8 - Resilient Pipe Vertical Sliding Guide: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin be removable and reinsertable to allow for selection of pipe movement. Guides be capable of motion to meet location requirements. Mason Type: VSG. Provide pipe

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- expansion hangers to control load shifts as the riser expands or contracts, Mason HES.
- L. Type FC-1, Flexible Duct Connectors. See Specification Section 23 33 00, Air Duct Accessories.
- M. Type FC-2A, Flexible Pipe Connector, Steel:
1. 321 stainless steel, close pitch, annular corrugated hose.
 2. Exterior Sleeve: 304 stainless steel, braided.
 3. Pressure Rating: 125 PSI at 70 degrees F for 12-inch and smaller pipe.
 4. Joint: ANSI Class 150 carbon steel flanges.
 5. Size: Use pipe sized units.
 6. Minimum Allowable Offset: 3/4-inch on each side of installed center line.
 7. Basis of Design: Metraflex Model MLP.
- N. Type FC-2B, Flexible Pipe Connector, Copper:
1. Inner Hose: Bronze, close pitch, annular corrugated hose.
 2. Exterior Sleeve: Braided bronze (for piping over 2-inches, to be 3 pound braided stainless steel).
 3. Minimum Allowable Pressure Rating: 125 PSI at 70 degrees F.
 4. Joint: Sweat ends.
 5. Size: Use pipe sized units.
 6. Minimum Allowable Offset: 3/8-inch on each side of installed center line.
 7. Basis of Design: Metraflex Model BBS.
- O. Type FC-2C, Flexible Pipe Connector, Gas:
1. Inner Hose: 304 stainless steel.
 2. Exterior Sleeve: Braided, 304 stainless steel.
 3. Minimum Allowable Pressure Rating: 150 PSI at 70 degrees F up to 4-inch pipe.
 4. Joint: Threaded carbon steel.
 5. Minimum Allowable Offset: 3/4-inch on each side of installed center line.
 6. Basis of Design: Metraflex GASCT.
- P. Type FC-3, Flexible Compensator, Double Sphere:
1. Body: Molded twin spherical type. Neoprene with internal cord or wire.
 2. Minimum Pressure Rating, Sizes 2-inch to 12-inch: 225 PSI at 170 degrees F.
 3. Minimum Pressure Rating, Sizes 14-inch to 20-inch: 125 PSI at 170 degrees F.
 4. Minimum Allowable Compression: 1-1/2 inches.
 5. Minimum Allowable Elongation: 1-1/8 inches.
 6. Minimum Allowable Offset: 1-1/8 inches.
 7. Minimum Allowable Angular Movement: 20 degrees.
 8. Joint: Steel flanges.
 9. Accessories: Galvanized aircraft-type cable or control rods to prevent over extension.
 10. Basis of Design: Metraflex Doublesphere.

2.3 SEISMIC RESTRAINT DEVICES

- A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- B. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts and replaceable resilient isolation washers and bushings. Snubber load rating to match equipment size. Mason Type: Z-1011 or Z-1225.
1. Anchor bolts for attaching to concrete be seismic-rated, drill-in and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.
- C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Mason Type: SCB.

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- D. Anchor Bolts: Seismic-rated, drill-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.4 FACTORY FINISHES

- A. Provide manufacturer's standard prime-coat finish ready for field painting. Units mounted outdoors exposed to weather: Epoxy powder coated, with 1000 hour salt spray rating per ASTM B-117. For high levels of corrosion protection utilize:
 - 1. Conform to AAMA 605.2.
 - 2. Apply coating following cleaning and pretreatment.
 - 3. Cleaning: AA-C12C42R1X.
 - 4. Dry system before final finish application.
 - 5. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.
- B. Finish:
 - 1. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment before shipping.
 - 2. Powder coating on springs and housings.
 - 3. Hardware be electrogalvanized. Hot-dip galvanize metal components for exterior use.
 - 4. Baked enamel for metal components on isolators for interior use.
 - 5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.5 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

- A. General Requirements for Restraint Components: Rated strengths, features and applications to be as defined in reports by agency acceptable to authorities having jurisdiction.
- B. Structural Safety Factor: Allowable strength in tension, shear and pullout force of components be at least four times maximum seismic forces to which they will be subjected.
- C. Anchor bolts for attaching to concrete to be seismic-rated, drill-in and stud-wedge or female-wedge type.
- D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
- E. Maximum 1/4-inch air gap and minimum 1/4-inch thick resilient cushion.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Set floor-mounted equipment with steel base rails on minimum 4-inch-high concrete housekeeping pads. Extend pad minimum 6-inches beyond footprint of equipment in each direction, but not less than twice the embedment depth of concrete anchors.
- B. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of isolated equipment.
- C. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.
- D. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances is isolation efficiency to be destroyed when bolting isolators to floor.
- E. Building Penetrations: Isolate water piping and ductwork penetrating wall, ceilings, floors or shafts from structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe or duct at equipment room wall.

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- F. Provide roof curbs, equipment supports and roof penetrations. Work to maintain roof warranty. Coordinate location, size, structural connections/requirements and flashing prior to installation.
- G. Install Type 6 horizontal thrust restraints at centerline of thrust, symmetrical on either side of equipment.
- H. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalignment shafts or bearings. Isolated equipment is to be level and in proper alignment with connecting ducts and pipes.
- I. Pipe Hangers in Equipment Rooms: Support water and gas piping connected to rotating equipment within equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment are to have a minimum of 1/2 static deflection of equipment isolators. Other isolators should have a minimum of 1/4 static deflection of equipment isolators.
- J. Examination:
 - 1. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances and other conditions affecting performance.
 - 2. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.
- K. Testing: Perform following field quality-control testing:
 - 1. Isolator seismic-restraint clearance.
 - 2. Isolator deflection.
 - 3. Snubber minimum clearances.
- L. Adjusting:
 - 1. Adjust snubbers according to manufacturer's written recommendations.
 - 2. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.
- M. Cleaning: After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt and debris.
- N. Demonstration: Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain air-mounting systems. Reference Division 01, General Requirements.

3.2 VIBRATION ISOLATION

- A. Reference General Installation Requirements above.
- B. Install per manufacturer's instructions and recommendations.
- C. Vibration isolators must be installed in strict accordance with manufacturer's written instructions and certified submittal data.
- D. Install isolation as indicated on Drawings by type and location and where indicated below.
- E. Equipment Vibration Isolation Schedule:

Equipment	Size	Vibration Isolator Type	Minimum Deflection (in)
Chillers/Heat Pumps: Reciprocating, Water or Air-Cooled	All	Type 4A or 4B, FC-3	2.5
Chillers/Heat Pumps: Centrifugal, Screw or Scroll, Water or Air-Cooled	All	Type 4A or 4B, FC-3	1.5
Cooling Towers	All	B-1, Type 4A, FC-3	3.5
Boilers	All	Type 1 or 2, FC-2	0.3

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Base-Mounted Pumps (Close-Coupled Only)	0 to 7.5 HP	B-2, FC-3	0.75
Base-Mounted Pumps	7.5+ HP	B-2, FC-3	1.5
Inline Pumps	All	Type 4A, 4B, 5B, or 5C, FC-2	1.5
Fan-Coils, Unit Heaters, Fan-Powered Terminal Units	All	Type 5B, or 5C, FC-1,2	0.75
Condensing Units	0 to 4.5 tons	Type 1 or 2	0.3
Condensing Units	5+ tons	Type 4A	2.5
Rooftop Air Handlers, AC, Heat Pump Units	0 to 19.5 tons	RC-1, FC-1,2	0.75
Rooftop Air Handlers, AC, Heat Pump Units	20+ tons	RC-2, FC-1,2	1.5
Utility Set Centrifugal Fans	All	4A	1.5
Axial, Cabinet, Centrifugal Inline Fans	0 to 23.5-inch diameter	Type 3, 4A, 4B, 5B, or 5C, FC-1	0.75
Axial, Cabinet, Centrifugal Inline Fans	24-inch+ diameter	Type 3, 4A, 4B, 5B, or 5C, FC-1	1.5
Propeller Fans	All	Type 2 or 5A, FC-1	0.25
Rooftop Grease Exhaust Ducts	All	Type 2	0.3

- F. Isolation Mounts:
1. Install minimum of four seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 2. Install resilient bolt isolation washers on equipment anchor bolts.
 3. Provide flexible piping connection and flexible ductwork connection to equipment with isolation mounts or bases.
- G. Isolating Hangers:
1. Support piping and ductwork connected to isolated equipment within equipment rooms on isolating hangers as scheduled on drawings. Unless otherwise noted, first three hangers from isolated equipment to have a minimum of 1/2 static deflection of equipment isolators. Other isolating hangers to have a minimum of 1/4 static deflection of equipment isolators.
 2. Position isolating hanger elements as high as possible in hanger rod assembly, but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
 3. Unless otherwise noted, air supply units with internally isolated fans do not require isolating hangers for connecting pipes and ductwork.
 4. Where parallel running pipes are hung together on an isolated trapeze, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in same trapeze.
 5. Install limit stops so they are out of contact during normal operation.
- H. Adjusting:
1. Adjust isolators after piping systems have been filled and equipment is at operating weight.
 2. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so

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they are out of contact during normal operation.

3. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

3.3 SEISMIC RESTRAINT DEVICES

- A. Reference General Installation Requirements above.
- B. Install in strict accordance with manufacturer's written instructions and certified submittal data.
- C. Install and adjust seismic restraints so equipment, piping and ductwork supports are not degraded by restraints.
- D. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.
- E. Install restraining cables at each trapeze, individual pipe hanger and hanging vibration isolated equipment. Provide restraining cables in each of the four directions of movement. Install restraining cables no less than 45 degrees from vertical. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- F. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

3.4 FACTORY FINISHES

- A. Reference General Installation Requirements above.
- B. Install per manufacturer's instructions and recommendations.
- C. Finishes to be factory-applied. No field patching or holidays allowed.

3.5 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

- A. Reference General Installation Requirements above.
- B. Install per manufacturer's instructions and recommendations.
- C. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Plastic Nameplates
 - 2. Tags
 - 3. Plastic Pipe Markers
 - 4. Ceiling Tags

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Schedules:
 - a. Submit valve schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.
 - 2. Submit schedule of identification type, including material, for each class of tagged item.
 - 3. Submit locations at which Valve Schedules will be installed.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

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PART 2 - PRODUCTS

2.1 PLASTIC NAMEPLATES

- A. Manufacturers:
 - 1. Brady Corporation
 - 2. Brimar
 - 3. Champion America
 - 4. Craftmark
 - 5. Seton
- B. Description: Engraving stock melamine plastic laminate in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Provide 1/8-inch thick material.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/2-inch.
 - 3. Background Color: Black.
 - 4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
 - 5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.

2.2 TAGS

- A. Manufacturers:
 - 1. Brady Corporation
 - 2. Brimar
 - 3. Champion America
 - 4. Craftmark
 - 5. Seton
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 2-inch diameter.
- C. Metal Tags: Polished Brass with stamped letters; tag size minimum 2-inch diameter with smooth edges.
- D. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
- E. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- F. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
- G. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7-inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

2.3 PLASTIC PIPE MARKERS

- A. Manufacturers:

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1. Brady Corporation
 2. Brimar
 3. Champion America
 4. Craftmark
 5. Seton
- B. Color: Conform to ASME A13.1 and ANSI Z535.1.
- C. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.
- E. Lettering:
1. 3/4-inch to 1-1/4-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 1/2-inch high letters.
 2. 1-1/2-inch to 2-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 3/4-inch high letters.
 3. 2-1/2-inch to 6-inch Outside Diameter of Insulation or Pipe: 12-inch long color field, 1-1/4-inch high letters.
 4. 8-inch to 10-inch Outside Diameter of Insulation or Pipe: 24-inch long color field, 2-1/2-inch high letters.
 5. Over 10-inch Outside Diameter of Insulation or Pipe: 32-inch long color field, 3-1/2-inch high letters.

2.4 CEILING TAGS

- A. Manufacturers:
1. Brady Corporation
 2. Brimar
 3. Champion America
 4. Craftmark
 5. Seton
- B. Description: Steel with 3/4-inch diameter color coded head.
- C. Color code as follows:
1. Yellow - HVAC equipment.
 2. Red - Fire dampers/smoke dampers.
 3. Blue - Heating/cooling valves.
 4. Ceiling tile labels, machine generated, adhesive backed tape labels with black letters, clear tape.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.
- B. Identify piping, concealed or exposed, with plastic pipe markers.
- C. Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
- D. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as

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IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

- E. Degrease and clean surfaces to receive adhesive for identification materials.
- F. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- G. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.
- H. Install all products in accordance with manufacturer's instructions.
- I. Manual Balancing Dampers: Provide 12-inch long orange marker ribbon to end of balancing damper handle.

3.2 PLASTIC NAMEPLATES

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners.
- B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.
- C. Identify thermostats with nameplates.

3.3 TAGS

- A. Use metal tags on piping 3/4-inch diameter and smaller.
- B. Tag balancing valves and major dampers with balanced GPM or CFM indicated after balancing is completed and accepted.
- C. Install tags with corrosion resistant chain.
- D. Small devices, such as in-line pumps, may be identified with tags.
- E. Identify valves with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.
- F. Identify air terminal units and radiator valves with numbered plastic tags.
- G. Tag automatic controls, instruments, and relays. Key to control schematic.
- H. Install valve schedule at each mechanical room.

3.4 PLASTIC PIPE MARKERS

- A. Install plastic pipe markers complete around pipe in accordance with manufacturer's instructions.
- B. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

3.5 CEILING TAGS

- A. Provide ceiling tags to locate valves, dampers, and equipment above accessible ceilings. Locate in corner of ceiling tee grid closest to equipment.

END OF SECTION

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Requirements and Procedures
 - 2. Ductwork Pressure Testing
 - 3. Fundamental Air Systems Balancing Procedures
 - 4. Temperature Control Verification
 - 5. Constant Volume Air Systems Balancing Procedures
 - 6. Pre-Balance Reporting
 - 7. Final Reports:
 - a. Report Requirements
 - b. General Report Data
 - c. System Diagrams
 - d. Air Handling Units
 - e. Fans
 - f. Duct Traverses
 - g. Diffusers/Registers/Grilles
 - h. Instrument Calibration
 - 8. Additional Tests

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Quality-Assurance Submittals: Submit two copies of evidence that the Testing, Adjusting, and Balancing (TAB) Agent and Project's TAB team members meet the qualifications specified in the "Quality Assurance" Article below.
 - 2. Pre-Construction Phase Report:
 - a. Provide a pre-construction phase TAB Plan at least two weeks prior to the commencement of TAB work. This report is to include:
 - 1) A complete set of report forms intended for use on the Project, with data filled in except for the field readings. Forms to be Project-specific.
 - 2) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
 - 3) Identification of the type, manufacturer, and model of the actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications to be included.
 - 4) A narrative of Project-specific and/or non-standard TAB procedures to be used, and the equipment or systems to which they apply.

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3. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit two copies of the Contract Documents review report as specified in Part 3 of this Section.
4. Strategies and Procedures Plan: Submit two copies of the TAB strategies and step-by-step procedures as specified in Part 3 of this Section. Include a complete set of report forms intended for use on this Project.
5. Specify reports required because of editing procedures in Part 3 of this Section.
6. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the TAB Agent.
7. Sample Report Forms: Submit two sets of sample TAB report forms.
8. Test Instrument Calibration: Submit proof of calibration within the last 6 months.
9. Final Report.
10. Provide additional submittals to commissioning authority as dictated in Commissioning Specifications.

1.5 **QUALITY ASSURANCE**

- A. Quality Assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 1. Acceptable TAB Agencies:
 - a. Oregon:
 - 1) Air Introduction and Regulations Inc.
 - 2) Accurate Balancing Agency Inc.
 - 3) Neudorfer Engineers
 - 4) Northwest Engineering Services
 - 5) Air Balancing Specialty Inc.
 - 6) Precision Test & Balance Inc.
 - 7) Testcomm
 - 8) American Commissioning and LEED Consultants, Inc.
 2. Balance Firm Qualifications:
 - a. General:
 - 1) Procure services of independent TAB agency to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum experience: 5 years.
 - 2) Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
 - b. Testing and Balancing firm is certified by NEBB or AABC and has a NEBB Certified Professional (CP) or a AABC Test and Balancer Engineer (TBE) on staff.
 - c. Industry Standards: Testing and Balancing will conform to NEBB or AABC, and American National Standards Institute (ANSI) as follows:
 - 1) NEBB: Comply with Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - 2) AABC: Comply with National Standards for Total System Balance.
 - 3) ANSI:
 - (a) S1.4 Specifications for sound level meters.
 - (b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
 - (c) ANSI S1.13 Methods for the Measurement of Sound Pressure Levels.
 - d. Test Observation: If requested, conduct tests in the presence of the Commissioning Authority, AHJ, Architect or the Architect's representative.
 3. Noise Criteria:

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- a. Noise levels in all 8 octave bands due to equipment and duct systems are not to exceed the following NC levels:

TYPE OF ROOM	NC LEVEL
Bathrooms and Toilet Rooms	35-40
Conference Room	30-35
Corridors (Public)	35-40
Lobbies, Waiting Areas	35-40
Offices, Large Open (3 or more occupants)	35-40
Offices, Small Private (2 or fewer occupants)	30-35
Kitchens	40-45
Classrooms (Small, Medium, Large)	30-35
Cafeteria/Dining	35-40
All Others	35-40

- b. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
- c. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.
4. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
 5. Owner Witness: Perform tests in the presence of the Commissioning Authority, Architect, Architect's Representative, or Owner's representative.
 6. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
 7. Simultaneous Testing: Test observations by the AHJ, the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.
 8. Do not perform TAB work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.
 9. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.
 10. TAB Conference: Meet with the Commissioning Authority, Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.
 - a. Agenda Items: Include at least the following:
 - 1) Submittal distribution requirements.
 - 2) Contract Documents examination report.
 - 3) TAB plan.
 - 4) Work schedule and Project site access requirements.
 - 5) Coordination and cooperation of trades and subcontractors.
 - 6) Coordination of documentation and communication flow.

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11. Certification of TAB Reports: This certification includes the following:
 - a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
12. TAB Reports: Use standard forms from NEBB or AABC.
13. Instrumentation Type, Quantity, and Accuracy: As described in NEBB or AABC.
14. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 **WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of outlet, coil, or device listed in the final TAB report.
 2. Guarantee: Meet the requirements of the following programs:
 - a. Provide a guarantee on NEBB or AABC forms stating that the agency will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1) The certified Agent has tested, adjusted, and balanced systems according to the Contract Documents.
 - 2) Systems are balanced to optimum performance capabilities within design and installation limits.

1.7 **DEFINITIONS**

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. TAB: Testing, Adjusting, and Balancing.
- K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- L. Test: A procedure to determine quantitative performance of a system or equipment.
- M. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- N. AABC: Associated Air Balance Council.

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- O. NEBB: National Environmental Balancing Bureau.
- P. AMCA: Air Movement and Control Association.
- Q. CTI: Cooling Tower Institute.
- R. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Witness leakage and pressure tests carried out by Section 23 31 00, HVAC Ducts and Casings.
- D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS AND PROCEDURES

- A. Project Conditions:
 - 1. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire TAB period. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.
 - 2. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.
 - 3. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.
- B. General Requirements:
 - 1. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
 - 2. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for TAB are clean and free from debris, dirt and discarded building materials.
 - 3. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner's operations.
- C. Examination:
 - 1. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - a. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - b. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - 2. Examine approved submittal data of HVAC systems and equipment.

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3. Examine Project record documents described in Division 01, General Requirements.
 4. Examine Architect's and Engineer's design data, including Basis of Design, HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
 5. Examine equipment performance data, including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
 6. Coordinate requirements in system and equipment with this Section.
 7. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
 8. Examine system and equipment test reports.
 9. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 10. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 11. Examine equipment for installation and for properly operating safety interlocks and controls.
 12. Report deficiencies discovered before and during performance of TAB procedures.
- D. Preparation:
1. Prepare a TAB plan that includes strategies and step-by-step procedures.
 2. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - a. Permanent electrical power wiring is complete.
 - b. Hydronic systems are filled, clean, and free of air.
 - c. Automatic temperature-control systems are operational.
 - d. Equipment and duct access doors are securely closed.
 - e. Balance, smoke, and fire dampers are open.
 - f. Isolating and balancing valves are open and control valves are operational.
 - g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - h. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.
 3. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - a. Attendance is required by installers whose work will be tested, adjusted, or balanced.
 4. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.
- E. General TAB Procedures:
1. Perform TAB procedures on each system according to the procedures contained in NEBB or AABC and this Section.

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2. Coordinate location of test probes prior to start of TAB procedures and make test probes available for Owner's tests after start of occupancy. Where required, cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
 3. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- F. Adjustment Tolerances:
1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
 2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
 3. Hydronic Systems: Adjust to within plus or minus 10 percent of design at coils and plus or minus 5 percent at system pumps and equipment.
 4. Adjust supply, return, and exhaust air quantities to maintain pressurization in spaces indicated on Drawings. Note and document room-to-room pressurization and maintain these relationships. Adjust pressure controlled spaces to within plus or minus 0.01 in WC.
- G. Recording and Adjusting:
1. Field Logs: Maintain written logs including:
 - a. Running log of events and issues.
 - b. Discrepancies, deficient or uncompleted work by others.
 - c. Contract interpretation requests.
 - d. Lists of completed tests.
 2. Ensure recorded data represents actual measured or observed conditions.
 3. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
 4. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.
 5. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
 6. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
 7. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner's Authorized Representative, or Commissioning Agent.
- 3.2 DUCTWORK PRESSURE TESTING
- A. Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved.
- B. Provide air pressure testing of ductwork as noted below for various project types and systems:
1. Supply and return ductwork located inside shafts and outside building envelope.
 2. Exhaust ductwork located inside shafts.
 3. Exhaust ductwork located outside building envelope, when used in a heat recovery system.
 4. For low-rise and high-rise multi-family, and single-residence Dwelling Units: not required.

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5. Exhaust systems serving compounding pharmacies, laboratories, laboratory support spaces, fume hoods, bio-safety cabinets, or hazardous exhausts: pressure test all ductwork.
 6. For other project types or systems: pressure test ductwork in accordance with SMACNA HVAC Air Duct Leakage Test Manual, of representative sections of installed ductwork totaling not less than the total installed duct areas noted below:
 - a. For variable air volume supply, return, or exhaust air systems' ductwork of higher than 2-inches pressure class: pressure test 40 percent of the total installed duct area.
 - b. For variable air volume supply, return, or exhaust air systems' ductwork of 2-inches or less pressure class: pressure test ductwork connected to 10-percent of the total installed duct area of such ductwork, but not less than ductwork connected to two terminal units. Where the tested 10-percent fails to comply, then pressure test 40-percent of the total installed duct area.
 - c. For constant air volume supply, return, or exhaust systems: pressure test 40-percent of the total installed duct area.
 7. Where tests are required, provide separate tests for each of supply, return and exhaust air systems.
 8. Where the tested 40-percent fails to comply with the requirements of this section, then pressure test 100-percent of the total installed duct area. Sections shall be selected by the building owner or the Architect and shall include sections of ductwork upstream and downstream of terminal units. Positive pressure leakage testing may be utilized for negative pressure ductwork.
 9. Area requirement of 40-percent of the total installed duct area is inclusive of ductwork located in shafts or outside building envelope.
- C. Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved. Pressure testing to meet the following leakage classifications below as a minimum (2012 SMACNA HVAC Air Duct Leakage Manual, Table 4-1):
1. Leakage class to be as defined below as a minimum.
 - a. Minimum Duct Leakage Classification

Duct Type	Leakage Class
Metal (Flexible excluded)	
Round and flat oval	3
Rectangular	6
 2. Testing machine: Meet requirements of SMACNA standards. Pacific Air Products "Port-O-Lab", Rolok, or United Sheet Metal.
 3. Test supply systems prior to connecting terminal units.
 4. Perform tests in presence of Owner's Authorized Representative. Give 48 hours advance notice before commencement of each test.
 5. Test ductwork systems in sections as large as possible and record test results accordingly.
 6. Leak test grease exhaust ductwork per requirements of latest edition of NFPA-96 and local Mechanical Code.
 7. Coordinate testing with ceiling installation.
 - a. Provide sheet-metal plates and install between each duct test section (applies to main-to-main fittings, branch-to-branch fittings and main-to-branch fittings). At each plate location, fabricate joint with Ductmate. Insert 14 gauge sheet metal between Ductmate using a neoprene gasket on both sides of metal plate.
 - b. Leave plates in place until isolated section has been tested and approved by Owner's Authorized Representative.

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- c. Once sections have passed test, remove plates and reattach Ductmate joints. After fan unit is running, test joint for leakage by using a mixture of soap and water. If noise or bubbling occurs, reseal joint. Owner's Authorized Representative to witness this procedure.
- 8. Test duct at 1.5 times the design air pressure, up to pressure class of the duct. Seal audible leaks.

3.3 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES

- A. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- B. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- C. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- D. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.
- E. Prepare schematic diagrams of systems' "as-built" duct layouts.
- F. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- G. Check the airflow patterns from the outside-air louvers and dampers and the return-air and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with thermal protection, sized for the connected load.
- J. Check dampers for proper position to achieve desired airflow path.
- K. Check for airflow blockages.
- L. Check that condensate drains are installed, trapped and primed and routed to drain.
- M. Check for readily observable leaks in air-handling unit components and ductwork.
- N. Use sheaves and pulleys to adjust the speed of belt drive fans to achieve design flow with motors running at 60 Hertz unless noted otherwise.

3.4 CONSTANT VOLUME AIR SYSTEMS BALANCING PROCEDURES

- A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer. Adjust fans to deliver design airflow at the lowest possible speed.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each air-handling unit component under final balanced condition.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Recommend corrective action to align design and actual conditions.
 - 4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor loading greater than full load amps. Do not increase fan speed beyond fan class rating. Modulate

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dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

6. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
7. Calibrate airflow measuring stations.

3.5 PRE-BALANCE REPORTING

- A. Pre-Construction Phase Report:
 1. Provide a pre-construction phase TAB Plan at least 2 weeks prior to the commencement of TAB work. This report is to include:
 - a. A complete set of report forms intended for use on the Project, with all data filled in except for the field readings. Forms to be Project-specific.
 - b. Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
 - c. Identification of the type, manufacturer, and model of actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.
 - d. A narrative of Project-specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.
- B. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- C. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced.

3.6 FINAL REPORTS

- A. Report Requirements:
 1. General:
 - a. Computer generated in PDF format and tabulated, divided, and bookmarked into sections by tested and balanced systems.
 - b. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.
 - 1) Include a list of the instruments used for procedures, along with proof of calibration.
 - c. Final Report Contents: In addition to the certified field report data, include the following:
 - 1) Pump curves
 - 2) Fan Curves
 - 3) Manufacturers Test Data
 - 4) Field test reports prepared by system and equipment installers
 - 5) Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data
- B. General Report Data:
 1. In addition to the form titles and entries, include the following data in the final report, as applicable:
 - a. Title Page
 - b. Name and Address of TAB Agent
 - c. Project Name
 - d. Project Location
 - e. Architect's Name and Address

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- f. Engineer's Name and Address
 - g. Contractor's Name and Address
 - h. Report Date
 - i. Signature of TAB Agent who Certifies the Report
 - j. Summary of Contents, Including the Following:
 - 1) Design versus Final Performance
 - 2) Notable Characteristics of Systems
 - 3) Description of System Operation Sequence if it varies from the Contract Documents
 - k. Nomenclature Sheets for Each Item of Equipment
 - l. Data for Terminal Units, including Manufacturer, Type Size, and Fittings
 - m. Notes to explain why certain final data in the body of reports vary from design values.
 - n. Test Conditions for Fans and Pump Performance Forms, Including the Following:
 - 1) Settings for Outside-, Return-, and Exhaust-Air Dampers
 - 2) Conditions of Filters
 - 3) Cooling Coil, Wet- and Dry-bulb Conditions
 - 4) Face and Bypass Damper Settings at Coils
 - 5) Fan Drive Settings, including Settings and Percentage of Maximum Pitch Diameter
 - 6) Inlet Vane Settings for Variable-Air-Volume Systems
 - 7) Settings for Supply-air, Static-pressure Controller
 - 8) Other System Operating Conditions that affect Performance
- C. System Diagrams:
- 1. Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
 - a. Quantities of Outside, Supply, Return, and Exhaust Airflows
 - b. Water and Steam Flow Rates
 - c. Duct, Outlet, and Inlet Sizes
 - d. Pipe and Valve Sizes and Locations
 - e. Terminal Units
 - f. Balancing Stations
- D. Air Handling Units:
- 1. For air-handling units, split systems, fan coils, pumps, and evaporator units with coils, include the following:
 - a. Unit Data: Include the following:
 - 1) Unit Identification
 - 2) Location
 - 3) Make and Type
 - 4) Model Number and Unit Size
 - 5) Manufacturer's Serial Number
 - 6) Unit Arrangement and Class
 - 7) Discharge Arrangement
 - 8) Sheave Make, Size in inches, and Bore
 - 9) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - 10) Number of Belts, Make, and Size
 - 11) Number of Filters, Type, and Size
 - b. Motor Data: Include the following:
 - 1) Make and Frame Type and Size
 - 2) Horsepower and rpm
 - 3) Volts, Phase, and Hertz
 - 4) Full-load Amperage and Service Factor
 - 5) Sheave Make, Size in Inches, and Bore

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- 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
- c. Test Data: Include design and actual values for the following:
 - 1) Total Airflow Rate in cfm (L/s)
 - 2) Total System Static Pressure in Inches wg (Pa)
 - 3) Fan rpm
 - 4) Discharge Static Pressure in Inches wg (Pa)
 - 5) Filter Static-pressure Differential in Inches wg (Pa)
 - 6) Preheat Coil Static-pressure Differential in Inches wg (Pa)
 - 7) Cooling Coil Static-pressure Differential in Inches wg (Pa)
 - 8) Heating Coil Static-pressure Differential in Inches wg (Pa)
 - 9) Outside Airflow in cfm (L/s)
 - 10) Return Airflow in cfm (L/s)
 - 11) Outside-air Damper Position
 - 12) Return-air Damper Position
 - 13) Vortex Damper Position
- E. Fans:
 - 1. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - a. Fan Data: Include the following:
 - 1) System Identification
 - 2) Location
 - 3) Make and Type
 - 4) Model Number and Size
 - 5) Manufacturer's Serial Number
 - 6) Arrangement and Class
 - 7) Sheave Make, Size in Inches, and Bore
 - 8) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - b. Motor Data: Include the following:
 - 1) Make and Frame Type and Size
 - 2) Horsepower and rpm
 - 3) Volts, Phase, and Hertz
 - 4) Full-load Amperage and Service Factor
 - 5) Sheave Make, Size in Inches, and Bore
 - 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - 7) Number of Belts, Make, and Size
 - c. Test Data: Include design and actual values for the following:
 - 1) Total Airflow Rate in cfm
 - 2) Total System Static Pressure in Inches wg
 - 3) Fan rpm
 - 4) Discharge Static Pressure in Inches wg
 - 5) Suction Static Pressure in Inches wg
- F. Duct Traverses:
 - 1. Include a diagram with a grid representing the duct cross-section and record the following:
 - a. Report Data: Include the following:
 - 1) System and Air-handling Unit Number
 - 2) Location and Zone
 - 3) Duct Static Pressure in Inches wg
 - 4) Duct Size in Inches
 - 5) Duct Area in SF
 - 6) Design Airflow Rate in cfm
 - 7) Design Velocity in fpm
 - 8) Actual Airflow Rate in cfm
 - 9) Actual Average Velocity in fpm

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- G. Diffusers/Registers/Grilles:
 - 1. For diffusers, registers and grilles, include the following:
 - a. Unit Data: Include the following:
 - 1) System and Air-handling Unit Identification
 - 2) Location and Zone
 - 3) Test Apparatus Used
 - 4) Area Served
 - 5) Air-terminal-device Make
 - 6) Air-terminal-device Number from System Diagram
 - 7) Air-terminal-device Type and Model Number
 - 8) Air-terminal-device Size
 - 9) Air-terminal-device Effective Area in SF
 - b. Test Data: Include design and actual values for the following:
 - 1) Airflow Rate in cfm
 - 2) Air Velocity in fpm
 - 3) Final Airflow Rate in cfm
 - 4) Final Velocity in fpm
 - 5) Space Temperature in Degrees F
- H. Instrument Calibration:
 - 1. For instrument calibration, include the following:
 - a. Report Data: Include the following:
 - 1) Instrument Type and Make
 - 2) Serial Number
 - 3) Application
 - 4) Dates of Use
 - b. Dates of Calibration

3.7 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

**SECTION 23 07 00
HVAC INSULATION**

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Type A, Flexible Glass Wool Blanket
 - 2. Type B, Duct Liner
 - 3. Type F, Closed-Cell Polyisocyanurate Rigid Foam Board
 - 4. Type 2, Flexible Elastomeric Pipe Insulation
 - 5. Jacketing
 - 6. Accessories
 - 7. Duct Insulation Accessories
 - 8. Duct Insulation Compounds
 - 9. Outdoor Ducting Cover

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Installer qualifications.
 - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
 - a. Where indicated R-values/ratings cannot be achieved by a single layer of insulation, describe how performance requirements will be achieved.
 - 3. 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.
 - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
 - 5. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
 - 2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.

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HVAC INSULATION**

3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with the requirements of current edition of UL "Pipe and Equipment Coverings R5583 400 8.15."
- C. Test duct insulation in accordance with current edition of ASTM E84, UL 723, NFPA 255, NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.1 TYPE A, FLEXIBLE GLASS WOOL BLANKET

- A. Acceptable Manufacturers:
 1. Certainteed
 2. Johns Manville
 3. Knauf
 4. Owens-Corning
- B. ASTM C553, Type 1, Class B-2; flexible blanket.
- C. 'K' Value: 0.27 BTU*in/(hr*sf°F) at 75 degrees F installed, maximum service temperature: 250 degrees F.
- D. Density: 0.75 pounds per cubic foot.
- E. DBDE-free. UL/E validated to be formaldehyde-free.
- F. Vapor Barrier Jacket: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

2.2 TYPE B, DUCT LINER

- A. Acceptable Manufacturers:
 1. Certainteed
 2. Johns Manville
 3. Knauf
 4. Owens-Corning
- B. ASTM C1071; flexible blanket.
- C. 'K' Value: ASTM C518, 0.25 BTU*in/(hr*sf°F) at 75 degrees F, maximum service temperature: 250 degrees F.
- D. Noise Reduction Coefficient: 0.65 or higher based on ASTM C 423 "Type A mounting."
- E. Maximum Velocity on Mat or Coated Air Side: 5,000 FPM.
- F. Adhesive: UL listed waterproof type.
- G. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
- H. Erosion-Resistant Surfaces: UL 181.
- I. ASTM G21 and ASTM G22 Microbial Growth Resistance.
- J. UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824 - "GREENGUARD Certification Program Method for Measuring Microbial

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Resistance." DBDE-free. UL/E validated to be formaldehyde-free.

- 2.3 TYPE F, CLOSED-CELL POLYISOCYANURATE RIGID FOAM BOARD
- A. Acceptable Manufacturers:
 - 1. Johns Manville
 - 2. Certainteed
 - 3. Knauf
 - 4. RMax
 - B. ASTM C1289, Type 1, Class 1.
 - C. Thermal Conductivity: 0.16 BTU*in/(hr*sf°F).
 - D. Service Temperature: -100 degrees F to 250 degrees F.
 - E. Jacketing: 0.016-inch thick multi-layered laminate with minimum tensile strength of 149-lb/inch, minimum puncture resistance of 49 pounds per ASTM D1000, maximum emittance of 0.03 per ASTM C1371, maximum WVTR of 0.00 perm per ASTM E96, and min/max service temperature of -40 degrees F to 300 degrees F, as manufactured by 3M, VentureClad1579GCW-E.
- 2.4 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION
- A. Acceptable Manufacturers:
 - 1. Insulation:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
 - 2. Glue:
 - a. Armacell LLC Armaflex Low VOC Adhesive
 - b. K-Flex
 - c. Or approved equivalent.
 - 3. Paint:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
 - B. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - 1. Thermal Conductivity Value: As indicated in the insulation tables below.
 - 2. Maximum Service Temperature of 220 degrees F.
 - 3. Maximum Flame Spread: 25.
 - 4. Maximum Smoke Developed: 50 (1-inch thick and below).
 - 5. Vapor Retarder Jacket, for over 1-inch insulation thickness: White Kraft paper reinforced with glass wool and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or vapor barrier mastic.
 - 6. Connection: Waterproof vapor retarder adhesive as needed.
 - 7. UV Protection: UV outdoor protective coating per manufacturer's requirements.
 - C. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.
 - D. Paint (for exterior insulation only): Nonhardening high elasticity type, specifically manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.
- 2.5 JACKETING
- A. Acceptable Manufacturers:
 - 1. ITW Insulation Systems
 - 2. General Insulation Company
 - 3. Johns Manville
 - 4. 3M
 - 5. Or approved equivalent.

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- B. Insulation Jacketing Tape: 0.016-inch thick multi-layered laminate with minimum tensile strength of 149-lb/inch, minimum puncture resistance of 49 pounds per ASTM D1000, maximum emittance of 0.03 per ASTM C1371, maximum WVTR of 0.00 perm per ASTM E96, and min/max service temperature of -40 degrees F to 300 degrees F, as manufactured by 3M, VentureClad1579GCW-E.
- C. PVC preformed molded insulation covers, for piping. Zeston or approved equivalent.
- D. Aluminum Jacket: 0.016-inch-thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory attached protective liner.
- E. Stainless Steel Jacket: Type 304 stainless steel, 0.010-inch, corrugated finish.
- F. Canvas Jacket: UL listed fabric, 6 ounce/sq.yd., plain weave cotton treated with dilute fire retardant lagging adhesive.

2.6 ACCESSORIES

- A. Acceptable Manufacturers:
 - 1. ITW Insulation Systems
 - 2. Or approved equivalent.
- B. Equipment Insulation Jacketing: Presized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.
- C. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- D. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water-soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.7 DUCT INSULATION ACCESSORIES

- A. Acceptable Manufacturers:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Owens-Corning
- B. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

2.8 DUCT INSULATION COMPOUNDS

- A. Acceptable Manufacturers:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Owens-Corning
- B. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated. Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168 in accordance with LLE EQ 4.1.

2.9 OUTDOOR DUCTING COVER

- A. Acceptable Manufacturers:
 - 1. 3M
 - 2. Certainteed
 - 3. Johns Manville
 - 4. Owens-Corning
- B. Aluminum Jacket: 0.016-inch-thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory attached protective liner.

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- C. Insulation Jacketing Tape: 0.016-inch thick multi-layered laminate with minimum tensile strength of 149-lb/inch, minimum puncture resistance of 49 pounds per ASTM D1000, maximum emittance of 0.03 per ASTM C1371, maximum WVTR of 0.00 perm per ASTM E96, and min/max service temperature of -40 degrees F to 300 degrees F, as manufactured by 3M, VentureClad1579GCW-E.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Verification of Conditions:
1. Do not apply insulation until pressure testing and inspection of ducts and piping has been completed.
 2. Examine areas and conditions under which duct and pipe insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Preparation: Clean and dry surfaces to be insulated.
- C. Installation:
1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
 2. Piping and Equipment:
 - a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
- D. Cover insulation on exposed refrigerant piping above ground, outside of building with heavy duty multi-layered laminated jacketing tape. Position seams on bottom of pipe. Use 3M VentureClad Plus 1579GCW-E or approved equal.
- E. Provide accessories as required. See Part 2 Article "Accessories" above.
- F. Protection and Replacement: Installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- G. Labeling and Marking: Provide labels, arrows and color on piping and ductwork. Attach labels and flow direction arrows to the jacketing per Section 23 05 53, Identification for HVAC Piping, Ductwork and Equipment.
- H. Ductwork:
1. Install insulation in conformance with manufacturer's recommendations to completely cover duct.
 2. Butt insulation joints firmly together and install jackets and tapes smoothly and securely.
 3. Apply duct insulation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapor barrier materials to form complete unbroken vapor seal over insulation.
 4. Coat staples and seals with vapor barrier coating.
 5. Cover breaks in jacket materials with patches of same material as vapor barrier. Extend patches not less than 3-inches beyond break or penetration on all directions and secure with adhesive and staples. Seal staples and joints with vapor barrier coating.
 6. Fill jacket penetrations, i.e., hangers, thermometers and damper operating rods, and other voids in insulation, with vapor barrier coating. Seal penetration with vapor barrier coating. Insulate hangers and supports for cold duct in un-

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conditioned spaces to extent to prevent condensation on surfaces.

7. Seal and flash insulation terminations and pin punctures with reinforced vapor barrier coating.
 8. Continue insulation at fire dampers and fire/smoke dampers up to and including those portions of damper frame visible at outside of the rated fire barrier. Insulating terminations at fire dampers in accordance with this Section.
 9. Do not conceal duct access doors with insulation. Install insulation terminations at access door in accordance with this Section.
- I. Insulated Pipe Exposed to Weather: Where piping is exposed to weather, cover insulation with aluminum jacketing. Seal jacketing watertight per manufacturer's recommendations. Install metal jacketing with 2-inch overlap at longitudinal and butt joints with exposed lap pointing down. Secure jacketing with stainless-steel draw bands 12-inches on center and at butt joints.
- J. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2-inches and larger (hot and cold) piping.
- K. Ductwork Surfaces to be Insulated: Oregon Climate Zone 4

Item to be Insulated	System Insulation Type	Duct Size	Minimum Installed R-Value
Supply ductwork inside building thermal envelope, where duct is not specified to be lined.	A	All	R-4
Return ductwork inside building thermal envelope, where duct is not specified to be lined.	--	All	None
Supply ductwork routed exposed within conditioned space where duct conveys air between 55°F and 105°F.	--	All	None
Supply and return ductwork located outside building thermal envelope (exposed to weather, above insulated ceilings, in crawl spaces, in parking garages).	A (for round ductwork) F (for rectangular ductwork)	All	R-8
Supply and return ductwork routed	A (for round ductwork)	All	R-6

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through unconditioned space outside building thermal envelope or buried below grade.	F (for rectangular ductwork)		
Outside air ducts inside building thermal envelope and upstream of automatic shutoff damper.	A, F	Airflow greater than or equal to 2800 cfm	R-16
Outside air ducts inside building thermal envelope and downstream of automatic shutoff damper.	A	Airflow greater than or equal to 2800 cfm	R-8
Outside air ducts inside building thermal envelope and upstream of automatic shutoff damper.	A	Airflow less than 2800 cfm	R-8
Combustion air ducts inside building thermal envelope.	A	All	R-8
Built up HVAC equipment plenums and unit housings not preinsulated.	B	All	R-6
Exhaust ducts within building thermal envelope, between energy recovery media, and automatic shutoff damper.	A	All	R-8
Exhaust ducts within building thermal envelope between exterior and automatic shutoff damper.	A	All	R-16

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Exposed insulation in mechanical rooms or areas subject to damage.	C, D	All	R-6
--	------	-----	-----

- Note: Insulation R-value shown is a minimum. If state codes require higher R-value, then provide insulation per code requirements.

L. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Conductivity Range (Btu-inch per hour per SF per degrees F)	Pipe Size (Inches)	Insulation Thickness (Inches)
Refrigerant Suction and Liquid Piping (40F to 60F)	2	0.21-0.27 at a mean rating temperature of 75 degrees F	<1	0.5
			1 to <1.5	0.5
			1.5 to <4	1.0
			4 to <8	1.0
			>= 8	1.0
Refrigerant Suction and Liquid Piping (<=40F)	2	0.20-0.26 at a mean rating temperature of 50 degrees F	<1	0.5
			1 to <1.5	1.0
			1.5 to <4	1.0
			4 to <8	1.0
			>= 8	1.5
Refrigerant Hot Gas Piping for VRF Systems	2	0.20-0.26 at a mean rating temperature of 50 degrees F	All	0.5

- Note: Insulation thickness shown is a minimum. If state code requires additional thickness, then provide insulation thickness per code requirements.

3.2 TYPE A, FLEXIBLE GLASS WOOL BLANKET

- Install insulation in conformance with manufacturer's recommendations and requirements.
- Duct Wrap: Cover air ducts per insulation table except ducts internally lined where internal duct lining is adequate to achieve adequate insulating values to meet local Energy Codes (indicate on shop drawings, locations where duct wrap is planned to be omitted and indicate internal duct lining insulating values to confirm they will meet the Energy Code). Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 2-inches. On ducts over 24-inches wide, additionally secure

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insulation with suitable mechanical fasteners at 18-inches on center. Circumferential and longitudinal joints stapled with flare staples 6-inches on center and covered with 3-inch wide, foil reinforced tape.

3.3 TYPE B, DUCT LINER

- A. Install insulation in conformance with manufacturer's recommendations and requirements.
- B. Duct Liners: Mat finish surface on air stream side. Secure insulation to cleaned sheet metal duct with continuous (minimum 90) percent coat of adhesive. Secure liner with mechanical fasteners 15-inches on center or per manufacturer requirements. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation overlap sides. Factory/field coat exposed edges. Metal nosing for exposed leading or transverse edges and when velocity exceeds 3500 FPM or manufacturer rating on exposed edges. Keep duct liner clean and free from dust. At completion of Project, vacuum duct liner if it is dirty or dusty. Do not use small pieces. If insulation is installed without horizontal, longitudinal, and end joints butted together, installation will be rejected and work removed and replaced with work that conforms to this Specification.

3.4 TYPE F, CLOSED-CELL POLYISOCYANURATE RIGID FOAM BOARD

- A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.5 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

- A. Flexible Elastomeric Insulation:
 - 1. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and below grade with two coats of finish as recommended by manufacturer.
- B. Flexible Elastomeric Tubing:
 - 1. Flexible Elastomeric Tubing: Slip insulation over piping or, if piping is already installed, slit insulation and snap over piping. Joints and butt ends must be adhered with 520 adhesive.
- C. See General Installation Requirements above.
- D. Install insulation in conformance with manufacturer's recommendations and requirements.
- E. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.
- F. Install in accordance with manufacturer's instructions for below grade installation.

3.6 JACKETING

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions.

3.7 ACCESSORIES

- A. Install insulation in conformance with manufacturer's instructions, recommendations and requirements.
- B. See General Installation Requirements above.
- C. Furnish and install accessories for all insulation types listed in this Section.

3.8 DUCT INSULATION ACCESSORIES

- A. Install insulation in conformance with manufacturer's recommendations and requirements.

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3.9 DUCT INSULATION COMPOUNDS

- A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.10 OUTDOOR DUCTING COVER

- A. Install insulation in conformance with manufacturer's recommendations and requirements.
- B. Outdoor Duct Exposed to Weather:
 - 1. Install jacket with brakes/slope to prevent standing water on duct. Use weatherable components.
 - 2. Weatherproof seal at joints and seams. Minimum 3-inch overlap.
 - 3. Label jacket every 6-feet and within 2-feet of building penetrations and equipment connections: "Do not stand or place equipment on duct."

END OF SECTION

SECTION 23 11 23
FACILITY FUEL - NATURAL GAS PIPING AND SYSTEMS

SECTION 23 11 23 - FACILITY FUEL - NATURAL GAS PIPING AND SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Fuel Pipe and Pipe Fittings - General
 - 2. Steel Pipe and Fittings, Above Grade
 - 3. Natural Gas Valves
 - 4. Gas Earthquake Valve
 - 5. Natural Gas Pressure Regulators
 - 6. Gas Solenoid Valves
 - 7. Flexible Pipe Connectors - Gas Piping (CSA Listed)

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Division 26, Electrical requirements for grounding fuel piping systems.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fuel Pipe and Pipe Fittings - General:
 - 1. Flange Gaskets:
 - a. Buna-N (Nitrile)
 - b. NBR
 - c. Viton
 - d. Or approved equivalent.
- B. Steel Pipe and Fittings, Above Grade:
 - 1. American Piping Products
 - 2. US Steel
 - 3. Or approved equivalent.
- C. Natural Gas Valves:
 - 1. Apollo
 - 2. Jenkins Bros.

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FACILITY FUEL - NATURAL GAS PIPING AND SYSTEMS

3. Lunkenheimer Co.
 4. Nibco
 5. Watts
 6. Or approved equivalent.
- D. Gas Earthquake Valve:
1. California Valve
 2. QuakeMaster
 3. Or approved equivalent.
- E. Natural Gas Pressure Regulators:
1. Maxitrol
 2. Equimeter
 3. Or approved equivalent.
- F. Gas Solenoid Valves:
1. ASCO Red Hat Series 8210 and 8030. Specific model numbers scheduled on Drawings.
 2. Or approved equivalent.
- G. Flexible Pipe Connectors - Gas Piping (CSA Listed):
1. Dormont
 2. Proflex
 3. Or approved equivalent.
- 2.2 FUEL PIPE AND PIPE FITTINGS - GENERAL
- A. Flange Gaskets: Gaskets to be constructed from elastomeric materials.
 - B. Install per manufacturer's recommended installation requirements.
- 2.3 STEEL PIPE AND FITTINGS, ABOVE GRADE
- A. Steel Pipe (Above Grade Installation):
1. ASTM A53, electric-resistance welded Type E, Grade B black pipe, manufactured for threaded pipe connections.
 - a. 2-inches and Smaller: Schedule 40, ASTM A53 black steel pipe and black malleable threaded fittings.
 - b. 2-1/2-inches and Larger: Schedule 40, ASTM A53 black pipe with butt weld fittings.
- B. Fittings for Steel Pipe (Above Grade Installations):
1. General: Mark fittings, unions, and other products recognized as regularly available products in accordance with MSS SP-25. Marking on products of small size or shape may be omitted from sequence allowed by MSS SP-25, except for manufacturer's name or trademark.
 2. Threaded Fittings: Conforming to ANSI B2.1, ASTM A47, 150 PSI rating, except where otherwise specified or prevailing codes or requirements dictate use of 300 PSI ratings. Fittings to be fabricated from standard malleable iron with dimensions conforming to ANSI B16.3.
 3. Welded Fittings: Wrought carbon steel fittings, ASTM A234, ANSI B16.9, B16.28. Butt-welding type unless otherwise indicated to be socket welding type.
 4. Flanges: Carbon steel conforming to ASTM A105, ANSI B16.5, and factory forged in USA. Flanges which have been machined, remade, painted, or are non-domestic origin are not acceptable. Provide raised or full face ends wherever indicated or required.
 5. Flange Gaskets: Gaskets to be constructed from elastomeric materials.
 6. Flange Hardware: Bolting materials to be corrosion resistant carbon steel bolts and hex nuts conforming to ASTM A307. Provide bolting materials used in containment sumps below grade applications, stainless steel bolts and hex nuts conforming to ASTM A453. Threads and dimensions to be in accordance with ANSI B1.1 and B18.2.

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FACILITY FUEL - NATURAL GAS PIPING AND SYSTEMS

7. Unions: Conform to ANSI B16.39, ASTM A47 and fabricated from malleable iron with bronze-to-iron ground joints rated at 150 percent design operating pressure. Threads to conform to ANSI B2.1.
8. Threaded Pipe Plugs: Conforming to ANSI B16.14.
9. Thread Lubricant: Meet or exceed CGA ratings and compliant with Federal Specification TT-S-1732, manufactured compatible with fuel oil.

2.4 NATURAL GAS VALVES

- A. 2-inches and Smaller: MSS SP-110 ball valves constructed in compliance with ASME B16.33. UL listed, FM approved, two-piece construction, threaded, bronze or brass body, full port, chrome plated brass ball, blowout-proof stem design, 125 PSI WOG working pressure.
- B. 2-1/2-inches and Larger: 100 to 125 PSI rated, all bronze or iron body/bronze trimmed plug cock type, square head or tee/lever handle operation. CSA listed.

2.5 GAS EARTHQUAKE VALVE

- A. Gas line valve providing automatic shutoff in case of earthquake. UL listed, CSA certified and FM approved. The valve or system to actuate shutoff means within 5 seconds when subjected to horizontal, sinusoidal oscillation having a peak acceleration of 0.3G (2.94 m/s²) and period of 0.4 seconds. Sensing means of valve or system not to actuate shutoff means when subjected for 5 seconds to horizontal, sinusoidal oscillations having:
 1. A peak acceleration of 0.4G (3.94 m/s²) with a period of 0.1 seconds,
 2. A peak acceleration of 0.08G (0.078 m/s²) with a period of 0.4 seconds, and
 3. A peak acceleration of 0.08G (0.078 m/s²) with a period of 1.0 second.
- B. Valve requires manual reset. Provide with needed spare parts to allow resetting after having been tripped. Valve to be same size as line size installed.

2.6 NATURAL GAS PRESSURE REGULATORS

- A. Natural Gas: Diaphragm and spring actuated type, with ventless or vented relief feature. Construction, pressure range, and venting features suitable for intended service. Regulator to meet code and serving utility requirements. Pipe vented type to atmosphere in approved location.

2.7 GAS SOLENOID VALVES

- A. General: Solenoid bodies will be brass construction with NPT ports. The valves will be "normally closed" and pilot operated or direct acting depending on application.
- B. Electrical: 125V/1ph/60Hz.
- C. Internal Construction: Type 304 and Type 316 internal parts, elastomeric seals and lubricants as appropriate for gas service.

2.8 FLEXIBLE PIPE CONNECTORS - GAS PIPING (CSA LISTED)

- A. Inner Hose: Type 304 stainless steel.
- B. Exterior Sleeve: Braided, Type 304 stainless steel.
- C. Pressure Rating: 175 PSI at 70 degrees F up to 4-inch pipe.
- D. Joint: Threaded carbon steel.
- E. Maximum Offset: 3/4-inch on each side of installed center line.
- F. Flexible Connectors: Flexible connectors used in LP and LPG piping systems compliant with following:
 1. Install in accordance with manufacturer's instructions.
 2. Flexible connectors and hose used as flexible connectors not exceed 3-feet in length where used with liquid or vapor piping on portable or stationary tanks.
 3. Hose permitted to be used if flexibility is required for liquid or vapor transfer.

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FACILITY FUEL - NATURAL GAS PIPING AND SYSTEMS

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Inspection: Examine areas and conditions under which fuel systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Identification: Install mechanical identification in accordance with Section 22 05 53, Identification for Plumbing Piping and Equipment.
- C. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- D. Remove scale and dirt on inside and outside before assembly.
- E. Prepare piping connections to equipment with flanges or unions.
- F. Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction protect open ends with temporary plugs or caps.
- G. Install piping systems in accordance with manufacturer's instructions.
- H. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- I. Install piping to conserve building space and avoid interference with use of space.
- J. Sleeve pipe passing through partitions, walls, and floors.
- K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- L. Provide piping mains, branches and runouts installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Provide stresses within allowable limits of ANSI B31.1 for pressure piping.
- M. Equipment Connections: Connect gas piping to each gas-fired equipment item, with drip leg and shutoff gas cock. Comply with equipment manufacturer's instructions. Flexible connections where required per ASCE 7-16 or shown on Drawings.
- N. Piping Tests: Test natural gas piping in accordance with applicable mechanical code requirements, ANSI B31.2, and local utility requirements at a minimum of 100 psig for 24 hours.

3.2 FUEL PIPE AND PIPE FITTINGS - GENERAL INSTALLATION

- A. Black Steel: See General Installation Requirements above and install per local code pressure test system to 100 psig for 24 hours.
- B. Fuel Piping Installation:
 - 1. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each route with a minimum of joints and couplings, but with adequate and accessible unions or flanges for disassembly, maintenance, and replacement of valves and equipment. Reduce sizes by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance. Comply with ANSI B31.9 Code for Pressure Piping. Provide shutoff valves, pressure regulators and unions at connections to gas-fired equipment. Provide dirt legs at low points.
 - 2. Installed piping not to interfere with maintenance of equipment, opening of doors or other moving parts nor be directly above or near any portion of electrical equipment.
 - 3. Support piping such that connected equipment does not bear weight of piping.
 - 4. Adequately support vertical lines at their bases or by suitable hanger placed in horizontal line near riser or, preferably, by base fitting set on a pedestal.
 - 5. Piping Through Roof: Coordinate roof penetrations prior to installation of piping. Coordinate location with roof structure and roof mounted equipment.
 - 6. Ream steel pipes after cutting to full bore. Remove foreign matter from inside of pipe before installing. Keep installed piping free from dirt and scale and protect

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FACILITY FUEL - NATURAL GAS PIPING AND SYSTEMS

open ends from foreign matter. Use temporary plugs or other approved methods for opening and closure.

7. Remake or replace defective, leaking, or otherwise unsatisfactory joints or material. Peening, caulking, or doping of piping is not permitted.
8. Threading: Thread steel pipe in accordance with ANSI B21.1 with standard right hand threads. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or proper pipe joint tape where recommended by pipe/fitting manufacturer on male threads at each joint and tighten joint to leave not more than three threads exposed.
9. Sealants: Use sealants on metal fuel piping threads which are chemically resistant to fuel. Use sealants sparingly and apply only to male threads of metal joints.
10. Maintain electrically continuous piping system; provide grounding jumper where required to maintain continuity. Provide grounding connection; install per requirements of Division 26, Electrical.
11. Install dirt legs in gas piping where indicated and where required by code or regulation. Do not rest dirt leg on surface of roof, floor or deck.
12. Support gas piping above roof on preformed pipe stands. Guide pipes with clamp one size larger than pipe. Provide supports at intervals per code manufacturer, and details and at each change in direction. Wood blocks are not approved supports.
13. Gas Regulator Vent Piping: Provide Schedule 40, A53 black steel pipe and threaded black malleable threaded fittings for vent piping. Paint piping exposed to weather with primer and one coat of Safety Yellow Rustoleum.
14. Piping: Paint piping exposed to weather with primer and one coat of Safety Yellow Rustoleum.

3.3 STEEL PIPE AND FITTINGS, ABOVE GRADE INSTALLATION

- A. See General Installation Requirements above and install per current version of manufacturer's installation guidelines. Test system in accordance with requirements of local code and ANSI LC-1.

3.4 NATURAL GAS VALVES INSTALLATION

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces and weld ends.
 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Do not attempt to repair defective valves; replace with new valves.
- D. Gas Cocks: Provide at connection to gas train for each gas-fired equipment item, and on risers and branches where indicated.
- E. Locate gas valves where easily accessible and protected from possible damage.

3.5 GAS EARTHQUAKE VALVE INSTALLATION

- A. Install in strict accordance with manufacturer's written instructions and approved submittals.
- B. Install earthquake valves per manufacturer's installation requirements. In a multi-building campus setting, provide a gas earthquake valve at each building gas point of entry whether shown on Drawings or not.

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FACILITY FUEL - NATURAL GAS PIPING AND SYSTEMS

- C. Gas Cocks: Provide at connection to gas train for each gas-fired equipment item, and on risers and branches where indicated.
- D. Locate gas valves where easily accessible and protected from possible damage.

3.6 NATURAL GAS PRESSURE REGULATORS INSTALLATION

- A. Install in strict accordance with manufacturer's written instructions and approved submittals.
- B. Vent regulators to outdoors as required.
- C. Pressure Regulating Valves: Install as required at gas-fired appliances; comply with utility/code requirements. Pipe atmospheric vent to outdoors, full size outlet with 90 degree elbow downturn. Install gas shutoff valve upstream of each pressure regulating valve. Install in accordance with manufacturer's instructions to prevent freezing.

3.7 GAS SOLENOID VALVES INSTALLATION

- A. Install in strict accordance with manufacturer's written instructions and approved submittals.
- B. Gas Cocks: Provide at connection to gas train for each gas-fired equipment item, and on risers and branches where indicated.
- C. Locate gas valves where easily accessible and protected from possible damage.

3.8 FLEXIBLE PIPE CONNECTORS - GAS PIPING (CSA LISTED) INSTALLATION

- A. Install in strict accordance with manufacturer's written instructions and approved submittals.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Ductwork, Joints, and Fittings
 - 2. Insulated Flexible Duct
 - 3. Drain Pans
 - 4. Ductwork Joint Sealers and Sealants

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 23 05 29, Hangers and Supports for HVAC Piping, Ductwork and Equipment.
 - 2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Welding Certificates.
 - 2. Field Quality Control Reports.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NFPA Compliance:
 - a. NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
 - b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
 - 2. Comply with NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations, Ch. 3, Duct System for range hood ducts, unless otherwise indicated.
 - 3. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Provide sheet metal materials free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
 - 4. Provide ductwork pressure testing and leakage testing per Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

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HVAC DUCTS AND CASINGS

1.7 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Duct design is generally diagrammatic and is not meant to be scaled. Major changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

PART 2 - PRODUCTS

2.1 DUCTWORK, JOINTS, AND FITTINGS

- A. Materials:
1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, lock-forming quality, ASTM A 653/A 653M FS Type B, with G90/Z275 coating, minimum 26 gauge except where heavier material is specified. Ducts to have mill phosphatized finish for surfaces exposed to view.
 2. Aluminum Ducts: ASTM B 209 (ASTM B 209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Minimum 24 gauge except where heavier material is specified; alloy 6061-T651 or of equivalent strength with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts with liquid-tight joints when containing condensate vapor or liquids in suspension.
- B. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 2. Deflection: Duct systems not-to-exceed deflection limits according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
 3. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
- C. Formed-On Flanges: construct according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 1-4, using corner, bolt, cleat, and gasket details.
1. Duct Size: Maximum 30-inches wide and up to 2-inch wg pressure class.
 2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
 3. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19-inches and larger and 0.0359-inch thick or less, with more than 10 SF of nonbraced panel area unless ducts are lined.
- D. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of material specified in this Section according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
1. Ducts up to 20-inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 2. Ducts 21- to 72-inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 3. Ducts Larger than 72-inches in Diameter: Companion angle flanged joints per SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2.
 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

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- E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's HVAC Duct Construction Standards-Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.
- F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows to be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's HVAC Duct Construction Standards-Metal and flexible, unless otherwise indicated.
 - 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
 - a. Ducts 3- to 36-inches in Diameter: 0.034-inch.
 - b. Ducts 37- to 50-inches in Diameter: 0.040-inch.
 - c. Ducts 52- to 60-inches in Diameter: 0.052-inch.
 - d. Ducts 62- to 84-inches in Diameter: 0.064-inch.
 - 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - a. Ducts 3- to 26-inches in Diameter: 0.034-inch.
 - b. Ducts 27- to 50-inches in Diameter: 0.040-inch.
 - c. Ducts 52- to 60-inches in Diameter: 0.052-inch.
 - d. Ducts 62- to 84-inches in Diameter: 0.064-inch.
 - 4. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 - 5. Round Elbows:
 - a. 8-inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend-angle configurations or non-standard diameter elbows with gored construction.
 - b. 9 through 14-inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60 and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - c. Larger than 14-inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 - 6. Die-Formed Elbows for Sizes through 8-inches in Diameter and Pressures 0.040-inch thick with two-piece welded construction.
 - 7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 - 8. Pleated Elbows for Sizes through 14-inches in Diameter and Pressures through 10-inch wg (2500 Pa): 0.022-inch.
 - 9. Not acceptable:
 - a. Corrugated or flexible metal duct.
 - b. Adjustable elbows.

2.2 INSULATED FLEXIBLE DUCT

- A. Manufacturers:
 - 1. ATCO
 - 2. Flexmaster
 - 3. J.P. Lamborn Co.
 - 4. Hart and Cooley

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HVAC DUCTS AND CASINGS

- B. Construction: Standard factory fabricated product. Inner wall: Impervious vinyl or chlorinated polyethylene, permanently bonded to a vinyl or zinc-coated spring steel helix.
- C. Insulation: Fiberglass blanket insulation covered by an outer wall of vinyl or fiberglass-reinforced metalized vapor barrier.
- D. Listing: UL 181 listed Class 1 flexible air duct material. Overall thermal transmission: No more than 0.25 BTU/in or hr/sq. degrees F at 75 degrees F differential, per ASTM C335.
- E. Vapor transmission value no more than 0.10 perm, per ASTM E96.
- F. Pressure Rating: 4-inch wg positive pressure and 1-inch wg negative pressure.
- G. Performance Air Friction Correction Factor: 1.3 maximum at 95 percent extension. Working air velocity: Minimum 2000 FPM.
- H. Flame Spread Rating: No more than 25.
- I. Smoke Development Rating: No more than 50 as tested per ASTM E84.
- J. Insertion Loss: Minimum attenuation of 29 DB for 10-foot straight length at 8-inch diameter at 500 Hz.

2.3 DRAIN PANS

- A. Primary Drain Pans: Stainless Steel, fabricated in accordance with ASTM A167 and A480.
- B. Secondary Drain Pans: Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating.

2.4 DUCTWORK JOINT SEALERS AND SEALANTS

- A. Manufacturers:
 - 1. Ductmate
 - 2. Duro Dyne
 - 3. Hardcast
 - 4. United McGill Corporation
 - 5. Vulkem
 - 6. Foster
 - 7. Childer
 - 8. Design Polymetrics (DP)
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
- C. Low Emitting Materials Requirement: Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
- D. Type: Heavy mastic or liquid, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure and leakage class of ducts.
- E. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.
- F. Water Based Sealant for Brush-On Application: Flexible, adhesive sealant, resistant to UV light, UL-181A, and UL-181-B listed, complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Hardcast Versa-Grip 181; Childers CP-146; Foster 32-19 for SMACNA 1/2, 1, 2, 3, 4, 6, and 10-inch WG duct classes, and SMACNA Seal Class A, B, or C.
- G. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
- H. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
- I. Polyurethane Sealant: General-purpose, exterior use, non-brittle sealant for gunned application. Vulkem 616 or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. General: Use the following pressure seal, and leakage class(es) in design of ductwork specified in this section unless otherwise noted on Drawings.

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SYSTEM	PRESSURE CLASS (Inches of Water)	SEAL CLASS	LEAKAGE CLASS ROUND DUCTS	LEAKAGE CLASS RECTANGULAR DUCTS
Medium Pressure Supply (fan to terminal unit)	0.5-inch higher than air handlers discharge pressure (min 4-inch pressure class).	A	2	4
Low Pressure (downstream of terminal unit)	+ 1-inch	A	2	4
Return and Exhaust	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	2	4
Kitchen Grease Exhaust	-6-inch	N/A	N/A	N/A

- B. Ductwork Installation:
1. General: Install entire duct system in accordance with drawings, Specifications, and latest issues of local Mechanical Code, NFPA 90A, and SMACNA Duct Construction Manual. At Contractor's option, rectangular ductwork may be resized to maintain an equivalent air velocity and friction rate, while maintaining a maximum aspect ratio of 3. Remove markings and tagging from ductwork exterior surface in mechanical rooms and other locations where ductwork is exposed.
 2. The duct layout shown on the Contract Drawings is diagrammatic in nature. Coordinate the ductwork routing and layout, and make alterations to the ductwork routing and layout to eliminate physical interferences. Where deviations in the ductwork routing as shown in the Contract Drawings are required, alterations may be made so as not to compromise the air flow, pressure drop, and sound characteristics of the duct fitting or duct run as shown on the Contract Drawings. In the event Architect determines that the installed ductwork is inconsistent with the above mentioned criteria, remove and replace at no additional cost to the Owner.
 3. Install ducts with fewest possible joints.
 4. Install fabricated fittings for changes in directions, size, shape, and for connections.
 5. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches, with a minimum of 3 screws in each coupling.
 6. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
 7. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 8. Install ducts with a clearance of 1-inch, plus allowance for insulation thickness. Allow for easy removal of ceiling tile.

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9. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
 10. Coordinate layout with suspended ceiling, air duct accessories, lighting layouts, and similar finish work.
 11. Electrical and IT Equipment Spaces: Route ducts to avoid passing through transformer vaults, electrical equipment spaces, IDF/MPOE rooms, and enclosures.
 12. Boiler Rooms and Refrigeration Machinery Rooms: Only route ducts serving these rooms through these rooms.
 13. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2-inches.
 14. Fire- and Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire, smoke or combination fire and smoke dampers as governed by Building Code and AHJ, including sleeves, and firestopping sealant.
 15. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Reference SMACNA's Seismic Restraint Manual: Guidelines for Mechanical Systems, Mason Seismic Restraint and Support Systems.
 16. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's Duct Cleanliness for New Construction Advanced Level.
 17. Paint interiors of metal ducts, that do not have duct liner, for 24-inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible duct material.
 18. Install ductwork in the location and manner shown and detailed. Review deviations required by job conditions with Architect prior to any fabrication. Provide fittings for construction per SMACNA.
 19. Install flexible ductwork to limit sag between support hangers to 1/2-inch per foot of spacing support.
- C. Flanged Take-Offs:
1. Install at branch takeoffs to outlets using round or flex duct.
 2. Flanged take-offs secured with minimum 8-inch screw spacing (three screws minimum).
 3. Provide ductwork taps and branches off of main ducts at 45 degrees whether shown on Drawings or not (drawings are diagrammatic).
- D. Cleaning:
1. 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 into ductwork for cleaning purposes.
 2. Grille and Exposed Duct Cleaning:
 - a. After completion of ductwork installation, operate each fan system (excluding exhaust fans) for a minimum of 30 minutes prior to installation of ceiling grilles and diffusers. After grilles and diffusers are installed, clean out accumulation of particles from grilles and diffusers prior to acceptance.
 - b. Clean exterior surface of ducts exposed to public view of chalk, pencil and pen marks, labels, sizing tags, dirt, dust, etc., so that upon completion of installation, ducts are left in clean and unblemished manufactured conditions.
 - c. Exposed duct and grilles to remain free of dust entrained streaks due to leakage at joints and grille connections during warranty period. Clean leaks, seal and refinish to match existing if visible streaks develop.

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**SECTION 23 31 00
HVAC DUCTS AND CASINGS**

3.2 DUCTWORK, JOINTS, AND FITTINGS INSTALLATION

A. Duct Materials - Applied Locations:

1. General: Use the following materials in design of ductwork specified in this Section unless otherwise noted on the Drawings.

Location or Application	Material
Supply, Return, Transfer, and Exhaust - Low Pressure (downstream of terminal units)	Single Wall, Galvanized Steel
Supply, Return, and Exhaust - Medium Pressure (upstream of terminal units)	Single Wall, Galvanized Steel
General Exhaust Branch Serving Air Inlet in Shower Room or Toilet Room with Shower	Single Wall, Aluminum

B. Ductwork Installation:

1. Fabricate radius elbows with centerline radius not less than 1-1/2 duct diameters.
2. Do not install duct size transition pitch angles which exceed 30 degrees for reductions in duct size in the direction of airflow, and 15 degrees for expansions in duct size in the direction of airflow.
3. Install fixed turning vanes in square throat rectangular elbows and in tees.
4. Fabricate duct turns with the inside (smallest) radius at least equal to the duct width (supply ducts) and 1.5 times radius (return and exhaust ducts). Where necessary, square elbows may be used, with maximum available inside radius and with fixed turning vanes. In healthcare settings such as hospitals and medical office buildings, square elbows and turning vanes allowed on supply ductwork only.

3.3 INSULATED FLEXIBLE DUCT INSTALLATION

A. Provide sheet metal plenum or rigid elbow and connect to diffusers and grilles with ductwork connections. Refer to Drawings for more information. Provide straight section of flexible duct with minimum length of 2-feet and maximum length of 5-feet and connect to sheet metal plenums and rigid elbows connected to diffusers and grilles, unless noted otherwise.

1. Provide round neck grilles/diffusers or square-to-round transitions. Flexible duct connections directly to diffuser and grilles is not allowed.
2. Flexible duct allowed in concealed spaces above lay-in ceilings only.

3.4 DRAIN PANS INSTALLATION

A. Install where shown on Drawings. Drain provided by Division 22, Plumbing. Provide drain (sized per code) connection from each drain pan and pipe to nearest floor drain through trap and 10-inch air gap. Drain pans over 6-feet in length require drain connections from both ends. Pitch drain pans in direction of air flow and to drain. Support secondary drain pan independently from equipment.

3.5 DUCTWORK JOINT SEALERS AND SEALANTS INSTALLATION

A. Joints and Seam Joint Sealing:

1. Seal duct seams and joints according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, for duct pressure class indicated.
2. Seal transverse joints, longitudinal seams and duct wall penetrations including screw, fastener, pipe, rod, and wire.
3. Seal ducts before external insulation is applied.
4. Fasteners such as sheet-metal screws, machine screws or rivets to be cadmium plated.
5. Rectangular Ductwork: Where intermediate joint reinforcement is required for duct of negative pressure class, pre-drill stiffening flange and provide fastener

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maximum 8-inches on center. Where retaining flanges are welded to duct wall, paint welds with zinc coating.

6. Single Wall Round Ductwork: Joint to incorporate beaded slip collar with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.
7. Seal joints and seams. Apply sealant to make end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
8. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
9. Provide openings in ductwork where required to accommodate thermometers and control devices. Provide pitot tube openings where required for testing of systems, complete with metal cap with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
10. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities as well as Code required clearances.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Sheet Metal Materials
 - 2. Backdraft Dampers
 - 3. Dampers
 - 4. Concealed Damper Hardware
 - 5. Access Doors
 - 6. Duct Test Holes
 - 7. Static Fire Dampers
 - 8. Control Dampers
 - 9. Turning Vanes
 - 10. Flexible Connectors

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Manufacturer's catalog data and fabrication/installation drawings for each factory fabricated duct accessory. Include leakage, pressure drop and maximum back pressure data.
 - 2. Shop Drawings: Indicate air duct accessories.
 - 3. Manufacturer's installation instructions: Provide instructions for each factory fabricated duct accessory.
 - 4. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. See Division 01, General Requirements, Product Requirements for additional provisions.
 - b. Extra Fusible Links: One of each type and size.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.
 - 2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
 - 3. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
 - 4. AMCA 511 - Certified Ratings Program for Air Control Devices.

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5. AMCA 611, latest edition - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations.
6. AMCA 610, latest edition - Laboratory Methods of Testing Airflow Measurement Stations for Performance Rating.
7. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
8. NFPA 92A - Smoke-Control Systems.
9. NFPA 101 - Life Safety Code.
10. UL 555 - Standard for Safety; Fire Dampers.
11. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M. Galvanizing: 1-1/4 ounces per square foot total both sides; ducts to have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

2.2 BACKDRAFT DAMPERS

- A. Manufacturers:
 1. Air Balance
 2. Cesco
 3. Greenheck
 4. Nailor
 5. Ruskin
- B. Basis-of-Design: Ruskin CB D6.
- C. Description: Multiple-blade gravity balanced with center pivoted blades with sealed edges, assembled in rattle free manner with 90-degree stop, adjustment device to permit setting for varying differential static pressure.
- D. Frame: 0.125-inch thick 6063-T5 extruded aluminum channel with galvanized steel braces at mitered corners. Provide mounting flange.
- E. Blades: Single piece, overlap frame, parallel action, horizontal orientation, minimum 0.07-inch 6063-T5 extruded aluminum material, maximum 6-inch width.
- F. Bearings: Corrosion-resistant synthetic, formed as single piece with axles.
- G. Blade Seals: Extruded vinyl, mechanically attached to blade edge.
- H. Blade Axles: Corrosion-resistant, synthetic formed as single piece with bearings, locked to blade.
- I. Tie Bars and Brackets: Galvanized steel.
- J. Return Spring: Adjustable tension.

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AIR DUCT ACCESSORIES

- K. Damper Capacity:
 - 1. Closed Position: Maximum back pressure of 16-inches water gauge.
 - 2. Open Position: Maximum air velocity of 2,500-feet per minute.
- L. Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade. Must be capable of operating over wide range of pressures.
- M. Finish: Mill aluminum.
- N. Temperature Rating: -40 degrees F to 200 degrees F.
- O. Operation of Blade:
 - 1. Start to Open: 0.01-inch wg
 - 2. Fully Open: 0.05-inch.
- P. Pressure Drop: Maximum 0.15-inch wg at 1,500-feet per minute through 24-inch by 24-inch damper.
- Q. Factory Sleeve: Minimum 20 gauge thickness, 12-inches in length.
- R. Screen: At outdoor intake or discharge. 1/4-inch aluminum.

2.3 DAMPERS

- A. Manufacturers:
 - 1. Air Balance
 - 2. Cesco
 - 3. Greenheck
 - 4. Nailor
 - 5. Ruskin
- B. Basis-of-Design:
 - 1. Rectangular ductwork for velocities and pressures up to 1,500 fpm and 2.5-inch wg, respectively: Ruskin MD-35.
 - 2. Rectangular ductwork for velocities and pressures up to 3,000 fpm and 4-inch wg, respectively: Ruskin CD-60.
 - 3. Round ductwork for velocities and pressures up to 3,000 fpm and 4-inch wg, respectively: Ruskin CDSR-15.
- C. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- D. Rectangular Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design with linkage concealed in frame and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - a. Roll-Formed Steel Blades: Galvanized sheet steel, 16 gauge thick for velocities up to 1,500 fpm, and 14 gauge thick for velocities up to 3,000 fpm.
 - b. Blade Axles: Minimum 1/2-inch diameter, plated steel, hex shaped, mechanically attached to blade.
 - c. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
 - d. Tie Bars and Brackets: Galvanized steel.
 - e. Mill galvanized.
- E. Round Volume Dampers: Single-blade suitable for horizontal or vertical applications.
 - 1. Steel Frames: Galvanized, roll formed, minimum of 20 gauge thick with beads at each end.
 - 2. Blades: Minimum 14 gauge thick, galvanized sheet steel, round, single-piece.
 - 3. Blade Axles: Minimum 1/2-inch square, plated steel, mechanically attached to blade.

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4. Bearings: Molded synthetic sleeve, turning in hole in frame.
 5. Finish: Mill galvanized.
 6. Capacity:
 - a. Closed Position: Maximum pressure of 4-inches wg.
 - b. Open Position: Maximum air velocity of 3,000-feet per minute.
 7. Leakage: Maximum 20 cfm at 4-inches wg.
 8. Pressure Drop: Maximum 0.02-inch wg at 1,500-feet per minute through 20-inch diameter dampers.
- F. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
 2. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include 2-inch elevated platform for insulated duct mounting.
- 2.4 CONCEALED DAMPER HARDWARE
- A. Manufacturers:
1. Young Regulator Company
- B. Concealed Damper Hardware: For dampers above non-removable ceilings (gyp, plaster, decorative, etc.) where access panels have not been shown on Architectural drawings or in locations where dampers are more than 2-feet above the ceiling, provide:
1. Concealed Damper Regulator: Young Regulator Company Model 315 or approved equivalent.
 2. Cable System: Young Regulator Company or approved equivalent.
 3. Controller: Young Regulator Company 270-275 or approved equivalent.
 4. Control wrenches, wire stops, casing nuts, and stainless steel wire.
 5. Paint cover plate to match ceiling color or as directed by Architect.
- 2.5 ACCESS DOORS
- A. Manufacturers:
1. Ductmate
 2. Cesco
 3. Ruskin
 4. Nailor
 5. Outdoor Installation: Karp MX insulated exterior access door.
- B. Duct Pressure Class 2-inch WC and Greater: Sandwich-type design with threaded locking bolt assembly. Closed cell neoprene gasket permanently bonded to inside panel. Zinc-coated steel wing nuts or polypropylene molded knobs with threaded metal inserts - zinc coated bolts sealed to inner panel.
- C. Duct Pressure Class 1-1/2-inch WC and Less: Galvanized steel assembly incorporating frame, door, hinges, and latch(es). Frame tabbed for attachment to duct panel. Double wall door panel with 1-inch insulation. Open cell neoprene gasket attached to frame. Cam latches for tight closure.
- D. Plenum Doors: Extruded aluminum frames with extruded santoprene seals. Double-wall 20 gauge galvanized steel door panel with fiberglass insulation.
- E. Size: Maximum size available to fit rectangular duct panel dimension or round duct diameter. Plenum doors minimum 2-feet wide by 4-feet high.
- F. For outdoor installation, only provide waterproof access doors installed vertically.
- 2.6 DUCT TEST HOLES
- A. Manufacturers:
1. Ventlok

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- B. Temporary Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- C. Permanent Test Holes (where shown on Drawings): Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.7 STATIC FIRE DAMPERS

- A. Manufacturers:
 - 1. Ruskin
 - 2. Greenheck
 - 3. Nailor
 - 4. Cesco
 - 5. Or approved equivalent.
- B. Basis-of-Design:
 - 1. Ruskin Model IBD2
- C. Fabrication:
 - 1. Fire Rating: UL 555 classified and provide fire dampers with UL label for fire rating as appropriate for wall rating and in conformance with NFPA 90A.
 - 2. Air Flow Rating: UL approved for dual directional air flow.
 - 3. Frame: Maximum 5-inches by minimum 20 gauge roll formed, galvanized steel channel.
 - 4. Blades:
 - a. Style: Curtain type, in airstream.
 - b. Action: Spring or gravity closure upon fusible link release.
 - c. Orientation: Horizontal.
 - d. Material: Minimum 24 gauge roll formed, galvanized steel.
 - 5. Closure Springs: Type 301 stainless steel, constant force type, if required.
 - 6. Temperature Release Device: 165 degrees F, 212 degrees F, or 285 degrees F.
 - 7. Mounting: Vertical or Horizontal, based on application.
 - 8. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.
 - 9. Assembly: Factory assemble damper and accessories and furnish as a single unit conforming to UL 555.
- D. Performance Data:
 - 1. Temperature Qualified: Damper qualified in accordance with UL 555 as a 1-1/2 hour fire damper.
 - 2. Pressure Drop: Maximum 0.1-inch wg at 2,000-feet per minute through 24-inch wide damper, no sleeve.
- E. Indicator Switches: Not required.
- F. Picture Frame Mounting Angles:
 - 1. One-piece, roll formed retaining angles.
 - 2. Factory matched and shipped on individual damper.
 - 3. Factory pre-punched screw holes.
 - 4. Requires factory sleeve.
- G. Factory Sleeve: Minimum 20 gauge thickness, minimum 12-inches length.
- H. Steel Mullions: For dampers in oversized masonry wall openings.
- I. Factory breakaway connection.
- J. Factory Tests: Factory cycle damper to assure proper operation.

2.8 CONTROL DAMPERS

- A. Manufacturers:
 - 1. Ruskin
 - 2. Greenheck
 - 3. Cesco
 - 4. Air Balance

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5. Nailor
- B. Basis-of-Design:
 1. Ruskin Model CDR25, low leakage, for use in low pressure round ductwork up to 24-inch diameter.
 2. Ruskin Model CDO25, low leakage, for use in low pressure oval ductwork.
 3. Ruskin Model CD60, ultra low leakage, for rectangular ducts or round ductwork larger than 24-inch diameter. Provide duct transition between round and rectangular connections.
- C. Fabrication:
 1. Frame: 16 gauge roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gauge U-channel.
 2. Blades (Low Leakage Dampers):
 - a. Style: Single skin with 3 longitudinal grooves.
 - b. Action: Opposed blade for modulating applications, parallel blade for two position application.
 - c. Orientation: Horizontal or vertical with thrust washers.
 - d. Material: Minimum 16 gauge equivalent thickness, galvanized steel.
 - e. Width: Nominal 6-inches.
 3. Blades (Ultra Low Leakage Dampers):
 - a. Style: Airfoil-shaped, single-piece.
 - b. Action: Opposed blade for modulating applications, parallel blade for two position applications.
 - c. Orientation: Horizontal or vertical with thrust washers.
 - d. Material: Minimum 14 gauge equivalent thickness, galvanized steel.
 - e. Width: Nominal 6-inches.
 4. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
 5. Seals:
 - a. Blade: Inflatable PVC coated fiberglass material and galvanized steel. Mechanically attached to blade edge.
 - b. Jamb: Flexible metal compression type.
 6. Linkage: Concealed in frame.
 7. Axles: Minimum 1/2-inch diameter plated steel, hex-shaped, mechanically attached to blade.
 8. Mounting: Vertical or horizontal.
 9. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.
- D. Performance Data (Low Leakage Dampers):
 1. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
 - a. Closed Position: Maximum pressure of 5-inches wg at a 12-inch blade length.
 - b. Open Position: Maximum air velocity of 2,000-feet per minute.
 2. Leakage: Maximum 3.7 cubic-feet per minute per square foot at 1-inch wg for sizes 36-inches wide and above.
 3. Pressure Drop: Maximum 0.07-inch wg at 1,500-feet per minute across 24-inch by 24-inch damper.
- E. Performance Data (Ultra Low Leakage Dampers):
 1. Leakage: Damper to have a maximum leakage of 3 cfm per square foot at 1-inch wg and be AMCA licensed as Class 1A.
 2. Differential Pressure:
 - a. Damper to have a maximum differential pressure rating of 13-inch wg for a 12-inch blade.
 3. Velocity: Damper to have a maximum velocity rating of 6,000-feet per minute.
 4. Temperature: Damper rated for -72 degrees F to 275 degrees F.
 5. Pressure Drop: Maximum 0.1-inch wg at 2,000-feet per minute across 24-inch by 24-inch damper.

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- F. Actuator: Provide actuator. See Specification Section 23 09 00, Instrumentation and Control for HVAC.
- G. Factory flange frame.
- H. Factory Sleeve: Minimum 20 gauge thickness.
- I. Duct Transition Connection: Per Drawings.
- J. Factory Tests: Factory cycle damper assembly to assure proper operation.

2.9 TURNING VANES

- A. Manufacturers:
 - 1. Aerodyne
 - 2. Ductmate Industries
 - 3. Duro Dyno Corp.
 - 4. Metalaire Inc.
- B. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners to automatically align vanes.
- C. Manufactured Turning Vanes: For medium pressure ductwork, ductwork upstream of terminal units, and in ductwork with equal inlet width and height dimensions and outlet width and height dimension, provide double thickness airfoil turning vanes. Low pressure ductwork and ductwork downstream of terminal units use either single thickness or double thickness turning vanes. For mitered rectangular elbows with changes in size from inlet to outlet, only use single thickness turning vanes. Use 2-inch radius vanes spaced on centers of 1.5-inches for single thickness. Use 2-inch radius vanes spaced on centers of 2.125-inches for double thickness.
- D. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.10 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Duro Dyne Corp.
 - 2. Ventfabrics Inc.
 - 3. Ductmate Industries
 - 4. Hardcast
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 4-inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.
- D. Provide a spring and bracket assembly to reinforce the fabric with sufficient tension to prevent connector collapse under negative or positive pressure. Number and positioning of spring-link fixture to be determined by the manufacturer to maintain straight axis and without kinks between two sections of duct, or between duct and the moving element. Hardcast Spring-Link SL-200, or equal.
- E. Indoor System, Flexible Connector Fabric (FC-I): Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 30 ounces per square yard.
 - 2. Tensile Strength: 395 pounds of force per inch in the warp and 255 pounds of force per inch in the filling.
 - 3. Service Temperature: -40 degrees F to 200 degrees F.
- F. Outdoor System, Flexible Connector Fabric (FC-O): Glass fabric double coated with Hypalon, resistant to UV rays and ozone.
 - 1. Minimum Weight: 26 ounces per square yard.
 - 2. Tensile Strength: 225 pounds of force per inch in the warp and 300 pounds of force per inch in the filling.
 - 3. Service Temperature: -40 degrees F to 200 degrees F.

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- G. High-Temperature System, Flexible Connectors (FC-HT): Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 30 ounces per square yard.
 - 2. Tensile Strength: 372 pounds of force per inch in the warp and 372 pounds of force per inch in the filling.
 - 3. Service Temperature: -70 degrees F to 500 degrees F.
- H. High-Corrosive-Environment System, Flexible Connectors (FC-HC): Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 ounces per square yard.
 - 2. Tensile Strength: 450 pounds of force per inch in the warp and 340 pounds of force per inch in the filling.
 - 3. Service Temperature: -67 degrees F to 500 degrees F.

PART 3 - EXECUTION

3.1 DUCT ACCESSORIES GENERAL INSTALLATION

- A. Inspect areas to receive air duct accessories. Notify Engineer of conditions that would adversely affect the installation of the dampers. Do not proceed until conditions are corrected.
- B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- C. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- D. Do not compress or stretch damper frames into duct or opening.
- E. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators, or jack shafts.
- F. Adjust duct accessories for proper settings.

3.2 SHEET METAL MATERIALS INSTALLATION

- A. Install bracing for multiple sections to support assembly weights and hold against system pressure. Install bracing as needed.

3.3 BACKDRAFT DAMPERS INSTALLATION

- A. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated. Provide at outside air intakes where motorized dampers are not shown on drawings.

3.4 DAMPERS INSTALLATION

- A. Where installing volume dampers in ducts with liner, avoid damage to and erosion of duct liner.
- B. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts for air balancing. Install at a minimum of two duct widths from each branch takeoff. Provide balancing dampers for all air inlets and outlets.
- C. Install dampers square and free from racking with blade running horizontally.

3.5 CONCEALED DAMPER HARDWARE INSTALLATION

- A. Coordinate location in Reflected Ceiling Plan and color of concealed damper hardware with Architect prior to installation.

3.6 ACCESS DOORS INSTALLATION

- A. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.

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AIR DUCT ACCESSORIES

2. Downstream from volume dampers, turning vanes and equipment.
 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
 5. Install the following sizes for duct-mounting, rectangular access doors:
 - a. One-Hand or Inspection Access: 8-inches by 5-inches.
 - b. Two-Hand Access: 12-inches by 6-inches.
 - c. Head and Hand Access: 18-inches by 10-inches.
 - d. Head and Shoulders Access: 21-inches by 14-inches.
 - e. Body Access: 25-inches by 14-inches.
 - f. Body Plus Ladder Access: 25-inches by 17-inches.
 6. Install the following sizes for duct-mounting, round access doors:
 - a. One-Hand or Inspection Access: 8-inches in diameter.
 - b. Two-Hand Access: 10-inches in diameter.
 - c. Head and Hand Access: 12-inches in diameter.
 - d. Head and Shoulders Access: 18-inches in diameter.
 - e. Body Access: 24-inches in diameter.
 7. Label access doors.
- 3.7 DUCT TEST HOLES INSTALLATION
- A. Provide test holes at fan inlets and outlets where indicated and where required for air testing and balancing.
- 3.8 STATIC FIRE DAMPERS INSTALLATION
- A. Adjust fire dampers for proper action.
 - B. Install fire dampers, with fusible links, and in accordance with manufacturer's UL approved written instructions.
- 3.9 CONTROL DAMPERS INSTALLATION
- A. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators or jack shafts.
 - B. Install control dampers in accordance with manufacturer's written instructions.
- 3.10 TURNING VANES INSTALLATION
- A. Vanes must be installed, eliminating every other vane is not allowed.
 - B. Single thickness vanes cannot be over 36-inches long without intermediate vane runner.
 - C. Install per SMACNA and fasten/support to prevent vibration, noise, and to maintain proper alignment at design velocity.
- 3.11 FLEXIBLE CONNECTORS INSTALLATION
- A. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Provide sheet metal weather cover over flexible connections located outdoors. Attach sheet metal to either equipment side or ductwork side, but not both.
 - B. Per NFPA, do not use flexible connectors on grease exhaust fans.
 - C. Securely attach spring-lock brackets to the metal strips of the connector collar using No. 8 sheet metal screws.
 - D. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
 - E. Adjust the following types in the following locations:
 1. FC-I: Indoors.
 2. FC-O: Outdoors.
 3. FC-HT: High temperature exhaust systems and smoke removal systems.
 4. FC-HC: High corrosive systems inclusive of all laboratory exhaust systems.

**SECTION 23 33 00
AIR DUCT ACCESSORIES**

END OF SECTION

SECTION 23 34 00
HVAC FANS

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Centrifugal Fans
 - 2. Roof Exhaust Fans
 - 3. Ceiling Exhaust Fans
 - 4. In-Line Centrifugal Fans

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gauges and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. For belt-driven fans, indicate the number of belts provided for design duty.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Motors: Premium efficiency. Electrically Commutated Motors (ECM) where scheduled on Drawings.
 - 2. Sound power levels as scheduled on Drawings. If not scheduled, within 5 percent of Basis of Design at design flow.
 - 3. Project Altitude: Base air ratings on sea-level conditions for project sites below 2,000 feet in elevation. Base air ratings on actual site elevations for project sites above 2,000 feet in elevation.
 - 4. Operating Limits: Classify according to AMCA 99.
 - 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 6. AMCA Compliance: Products are to comply with performance requirements and are to be licensed to use the AMCA-Certified Ratings Seal.
 - 7. NEMA Compliance: Motors and electrical accessories are to comply with NEMA standards.
 - 8. UL Standard: HVAC Fans are to comply with UL 705. Fans used in grease exhaust applications are to be UL 705 - Supplement SC listed for grease exhaust. Fans used for smoke control applications are to be UL 705 - Supplement SD listed for Power Ventilators for Smoke Control.

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HVAC FANS

9. Belt-driven fans used for smoke control applications are to have 1.5 times the number of belts required for the design duty, with the minimum number of belts being two.

1.6 **WARRANTY**

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 **DELIVERY, STORAGE, AND HANDLING**

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
C. Lift and support units with manufacturer's designated lifting or supporting points.

1.8 **COORDINATION**

- A. Coordinate size and location of structural-steel support members.
B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.9 **EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 **CENTRIFUGAL FANS**

- A. Manufacturers:
1. Greenheck
2. Cook
3. Twin City
- B. Description: Centrifugal or utility type centrifugal fans, as indicated, standard factory finish, AMCA rated, single width, single inlet, double width, double inlet, forward curved, backward inclined, or airfoil blades as scheduled.
- C. Wheel and Inlet:
1. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
2. Airfoil Wheel: Steel construction with smooth curved inlet flange, heavy back plate die formed hollow airfoil shaped blades continuously welded at tip flange, and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
3. Statically and dynamically balance wheel within its own bearings with maximum balance quality grade at bearings of G16 (0.20 in/sec peak velocity, filter-in as measured at fan RPM) for 5 hp and below and G6.3 (0.15 in/sec peak velocity, filter-in as measured at fan RPM) for 7.5 hp and above per ANSI S2.19. AMCA 210 rated.
- D. Housing:
1. Heavy gauge steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut.

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HVAC FANS**

2. Finish: Factory finish to manufacturer's standard (Permatector). Prime coating of aluminum parts is not allowed.
 3. Removable angles and bolts for attaching flexible connections and discharge dampers on fan outlet.
 4. Housing Discharge Arrangement: Adjustable to eight standard positions.
- E. Bearings and Drives:
1. Bearings: Heavy duty pillow block type, self-greasing ball bearings, with ABMA 9 L-10 life at 100,000 hours.
 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard. Provide anti-corrosive coating.
 3. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 5 hp and under, selected so required rpm is obtained with sheaves set at mid-position fixed sheave for 7.5 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 5. Belt Guard: Fabricate to SMACNA Duct Construction Standards - Metal and Flexible; 0.106-inch thick, 3/4-inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
- F. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.
- G. Accessories:
1. Inlet/Outlet Screens: Galvanized steel welded grid, removable, at unit outlet for outdoor installation, and unit inlet for unducted conditions.
 2. Access Doors: Shaped to conform to scroll, with quick opening latch type handles and gaskets.
 3. Scroll Drain: 1/2-inch steel pipe coupling welded to low point of fan scroll for outdoor installation.
 4. AMCA 99 Type B spark proof construction where scheduled.
 5. Protective coating on fan wheel and interior of fan housing where scheduled. Apply coating before balancing fans and repair any breaks in coating which occur during balancing. One 6-mil coat of white plastic #7122 and one 6-mil coat of black plastic #7122.
 6. Vibration isolation as scheduled and specified. Reference Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.

2.2 ROOF EXHAUST FANS

- A. Manufacturers:
1. Greenheck
 2. Cook
 3. Twin City
- B. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Wheel:
1. Single width, single inlet, backward inclined/airfoil blades.
 2. Aluminum hub and wheel with steel inlet bell.
 3. Statically and dynamically balanced with its own bearings.
- D. Housing to match scheduled Basis of Design:
1. One piece heavy gauge spun aluminum dome, hinged for service.
 2. Low silhouette type with arched heavy gauge galvanized hood.
 3. Louvered type with heavy gauge extruded aluminum louvers.

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HVAC FANS**

- 4. Upblast discharge, heavy gauge spun aluminum, UL 705 - Supplement SC for kitchen grease exhaust. Provide rain and snow drains.
- E. Bearings and Drives:
 - 1. Bearings: Heavy duty pillow block type, self greasing ball bearings with ABMA 9 L-10 life at 100,000 hours.
 - 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil.
- F. Pulleys: Cast-iron, adjustable-pitch motor pulley.
- G. Fan and motor isolated from exhaust airstream.
- H. Curb: Prefabricated insulated roof curb, galvanized steel, mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer, hinged with curb seal. Provide curb for flat, pitched or ridged roof as indicated.
 - 1. Sound curb: Curb with sound-absorbing insulation matrix. Provide where scheduled.
- I. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.
 - 1. Inverter duty motor for use with variable frequency drive where indicated on Fan Schedule on Drawings.
 - 2. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.
- J. Accessories:
 - 1. Inlet/Outlet Screens: Galvanized steel welded grid, removable.
 - 2. Backdraft Damper: Parallel blade heavy duty steel or aluminum, where scheduled, damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever. Motorized where indicated and gravity actuated with counterweight, where motorized is not indicated.
 - 3. Protective coating on fan wheel and interior of fan housing where scheduled. Apply coating before balancing fans and repair any breaks in coating which occur during balancing. One 6-mil coat of white plastic #7122 and one 6-mil coat of black plastic #7122.
 - 4. Variable-Speed Controller: Where scheduled on Drawings, provide solid-state control to reduce speed from 100 percent to less than 50 percent.
 - 5. Disconnect Switch: Where not shown on Division 26, Electrical Drawings, provide nonfusible type, with thermal-overload protection mounted inside fan housing factory wired through an internal aluminum conduit.
 - 6. Vibration Isolation: Wheel and motor mounted on integral double deflection neoprene isolators.

2.3 CEILING EXHAUST FANS

- A. Manufacturers:
 - 1. Greenheck
 - 2. Cook
 - 3. Broan
 - 4. Twin City
 - 5. Panasonic
- B. Description: Centrifugal fan, direct drive, cabinet and exhaust grille. AMCA rated. Low sone model. Fan shrouds, motor, and fan wheel are to be removable for service.
- C. Wheel: Double width, double inlet, forward curved blades:
- D. Housing: Acoustically insulated steel casing, factory standard finish, bottom access through grille, ducted outlet, egg crate inlet grille. Provide stainless steel grille where scheduled.
- E. Drives: Direct drive.
- F. Back draft damper.
- G. Accessories:

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1. Disconnect plug.
 2. Flat roof cap.
 3. Hooded wall cap.
 4. Pitched roof cap.
 5. Elbow discharge with grille.
 6. Louvered wall discharge with bird screen.
- H. Motor: Integrally mounted with pre-lubricated sealed ball bearings. Engineered and rated to run continuously.
1. Variable-Speed Controller: Where scheduled on Drawings, provide solid-state control to reduce speed from 100 percent to less than 50 percent.
 2. Disconnect Switch: Where not shown on Division 26, Electrical Drawings, provide nonfusible type, with thermal-overload protection mounted inside fan housing factory wired through an internal aluminum conduit.
 3. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
 4. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
 5. Motion Sensor: Motion detector with adjustable shutoff timer.
 6. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.
- I. Filter: Washable aluminum to fit between fan and grille.
- J. Isolation: Rubber-in-shear vibration isolators.

2.4 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers:
1. Greenheck
 2. Cook
 3. Twin City
- B. Description: In-line centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Wheel: Cast aluminum backward inclined with inlet cone statically and dynamically balanced within its own bearings.
- D. Housing:
1. Heavy gauge steel or aluminum housing, suitable for Fan Class, factory standard finish.
 2. Removable panels for access to all interior components.
 3. Horizontal or vertical configuration, as indicated.
 4. Inlet and discharge duct collars.
 5. 1-inch thick, 1.5 pounds per cubic foot density fiberglass liner.
 6. Aluminum straightening vanes.
 7. Support bracket adaptable to floor, sidewall, or ceiling mounting.
- E. Bearings and Drives:
1. Bearings: Heavy duty pillow block type, self greasing ball bearings with ABMA 9 life at 50,000 hours.
 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil.
 3. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 5 hp and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 7.5 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor. Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

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- a. Inverter duty motor for use with variable frequency drive where indicated on Fan Schedule on Drawings.
- 4. Drive: Direct drive matched to fan loads with speed controller. Motor encased in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.
 - a. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.
- F. Accessories:
 - 1. Belt guard.
 - 2. Variable-Speed Controller: Provide solid-state control to reduce speed from 100 percent to less than 50 percent for motors 1/2 HP or smaller.
 - 3. Discharge Dampers: Parallel blade for mixing or open/close applications and opposed blade for modulating . Heavy duty steel or aluminum, where scheduled. Damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever. Motorized where indicated and gravity actuated with counterweight, where motorized is not indicated.
 - 4. Flat roof cap.
 - 5. Hooded wall cap.
 - 6. Pitched roof cap.
 - 7. Elbow discharge with grille.
 - 8. Louvered wall discharge with bird screen.
- G. Inlet/Outlet Screens: Galvanized steel welded grid, removable.
- H. Vibration Isolation: Wheel and motor mounted on integral double deflection neoprene isolators.
- I. Vibration isolation as scheduled and specified. Reference Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.
 - 1. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install in accordance with manufacturer's instructions.
- B. Install power ventilators level and plumb.
- C. Fans used for exhaust of kitchen grease hoods are to be UL 705 - Supplement SC listed for grease exhaust. Provide fans with grease terminator. Pipe from grease terminator to Code approved location.
- D. Fans used for exhaust of moist air are to be constructed of aluminum construction and be warranted for their application in moist conditions.
- E. Fans used in welding, chemical, and/or fume exhaust applications are to be of spark-proof construction and are to be protected with coatings as required to protect parts in the air stream from the chemicals and materials the fan will be exposed to.
- F. Install floor-mounting units on concrete bases.
- G. Units using vibration isolation devices are scheduled on Drawings.
- H. Support suspended units from structure threaded steel rods and vibration isolation device scheduled on Drawings.
- I. In seismic zones, restrain support units.
- J. Install units with clearances for service and maintenance.
- K. Provide fixed sheaves required for final air balance.
- L. Provide safety screen where inlet or outlet is exposed.
- M. Pipe scroll drains to nearest floor drain.
- N. Provide backdraft dampers on discharge of exhaust fans and as indicated on Drawings.

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- O. Duct installation and connection requirements are specified in other Division 23, HVAC Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors per Section 23 33 00, Air Duct Accessories.
- P. Install ducts adjacent to power ventilators to allow service and maintenance.
- Q. Ground equipment.
- R. 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.
- S. Equipment Startup Checks:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Verify lubrication from bearings and other moving parts.
 - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 7. Disable automatic temperature-control operators.
- T. Starting Procedures:
 - 1. Energize motor and adjust fan to indicated rpm.
 - 2. Measure and record voltage and amperage.
- U. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- V. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- W. Shut unit down and reconnect automatic temperature-control operators.
- X. Replace fan and motor pulleys as required to achieve design airflow.
- Y. Provide totally enclosed fan cooled motors when motor is located outdoors, whether under a cover or not, or exposed to moisture. Provide protective covering for electronically commutated motors located in outdoor or wet/wash-down locations.
- Z. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- AA. Adjust damper linkages for proper damper operation.
- BB. Adjust belt tension.
- CC. Lubricate bearings.
- DD. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- EE. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- FF. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

3.2 ROOF EXHAUST FANS

- A. Secure roof exhaust fans to roof curbs with cadmium-plated hardware.

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HVAC FANS

3.3 CEILING EXHAUST FANS

- A. Suspend units from structure; use steel wire or metal straps.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Grilles, Registers, Diffusers
 - 2. Louvers

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size and accessories furnished.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Air Distribution Diffuser, Register, and Grille Schedule lists Basis of Design, with any specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design:
 - a. Construction materials and appearance.
 - b. Frame/installation method.
 - c. Isothermal throw plus or minus 5 percent at design flows shown on drawings.
 - d. Noise Criteria: NC value plus or minus 1 at design flows shown on drawings.
 - e. Accessories: Equal to Basis of Design.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23, HVAC sections, where more than a single

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AIR OUTLETS AND INLETS

type is specified for the application, provide single selection for each product category.

- B. Grilles, Registers, Diffusers:
 - 1. Anemostat
 - 2. Carnes
 - 3. Environmental Air Products
 - 4. Krueger
 - 5. Metalaire
 - 6. Nailor
 - 7. Price Co.
 - 8. Shoemaker
 - 9. Titus
 - 10. Tuttle & Bailey
 - 11. Seiho
 - 12. Or approved equivalent.
- C. Louvers:
 - 1. Ruskin Manufacturing
 - 2. Pottorff
 - 3. Carnes
 - 4. Cesco
 - 5. Greenheck
 - 6. Or approved equivalent.

2.2 GRILLES, REGISTERS, DIFFUSERS

- A. Diffuser, Register and Grille Schedule lists Basis of Design, with specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design, including accessories and finish:
 - 1. Matching construction materials and appearance. Equal installation method/frame.
 - 2. Pressure drop equal to or less than Basis of Design at CFM on Drawings.
 - 3. Throw: Isothermal jet throw plus or minus 5 percent of Basis of Design at CFM listed on Drawings.
 - 4. Noise Criteria: Plus or minus 1 NC of Basis of Design at CFM listed on Drawings. If Basis of Design NC is below registered level, submitted must match. NC rating with 10 dB room factor or less.
- B. Provide 1-, 2-, 3-, or 4-way deflection.
- C. Provide pattern controllers for linear supply air diffusers.
- D. Register Dampers: Dampers utilized with grilles. Opposed blade dampers utilizing a side operated worm drive which provides external duct operation. Slot the end of the shaft to receive a screwdriver. Factory assembled side operator. Construct of the same material as the grille. Manufacturer same as grilles/diffuser.
- E. Coordinate mounting frames with ceiling construction type. Verify per reflected ceiling plans.

2.3 LOUVERS

- A. General: Frame and sill styles compatible with adjacent substrate, specifically manufactured to fit into construction openings with accurate fit and adequate support for weatherproof installation. Reference Drawings and Specifications for types of substrate which will contain each type of louver. Construct of aluminum extrusions, ASTM B221, Alloy 6063-T5. Weld units or use stainless steel fasteners. On inside face of exterior louvers, provide anodized aluminum wire bird screen mounted in removable extruded aluminum frames. AMCA licensed performance ratings.
- B. Blades set 3 to 5-inches on center, 37.5 degree angle with rain hook on blade, minimum blade thickness 0.080-inch, drainable blade style. Minimum 57 percent free area for 48-by 48-inch unit. Maximum water penetration 0.01 ounce water psf free area at 1000 FPM. Maximum intake pressure drop of 0.10-inch wg at 750 FPM free velocity. Provide

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downspouts in jambs, designed to drain water from louver for minimum water cascade from blade to blade. Provide drain gutter in head frame and each blade.

- C. Reference Drawings for free area required.
- D. Provide access door in duct to clean birdscreen.
- E. Finish: Factory Kynar 500 fluoropolymer spray finish; color to be selected by Architect. Conform to AAMA 605.2. Apply coating following cleaning, and pretreatment. Dry louvers before final finish application. 1.2 mils total dry film thickness when baked at 450 degrees F for ten minutes.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install in accordance with manufacturer's instructions. Provide seismic supports, clips, and bracing per local code. Coordinate installation of framing. Provide complete coverage of rough openings by integral device flanges or auxiliary frames. Where above ceiling location is unconditioned space, caulk rough openings; repair and re-paint locations where dust entrainment streaks develop due to unsealed openings.
- B. Damp locations, such as lockers, restrooms, showers, natatoriums, whirlpool/spas, to have aluminum construction even if scheduled otherwise; mounting hardware to be stainless steel.
- C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- D. Unless otherwise shown on drawings, for ceiling mounted air outlets with adjustable airflow pattern controllers mounted at a height of 12 feet or less, adjust the air outlets for horizontal air distribution, and adjust to vertical air distribution for ceiling height above 12 feet.
- E. Exterior color of grilles per Architect. White finish if not otherwise scheduled or noted by Architect. Paint ductwork visible behind air outlets and inlets matte black.
- F. Ceiling Membrane: Protect ceiling membrane per code. Fire caulk around openings. Provide listed radiation damper in rated roof/ceiling or floor/ceiling assemblies as required per code.
- G. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

3.2 GRILLES, REGISTERS, DIFFUSERS INSTALLATION

- A. Coordinate with Architectural Reflected Ceiling Plan(s). Reflected ceiling plans determine final locations.
- B. Install diffusers to ductwork with air tight connection. 18-inch straight duct section or acoustic plenum at connection. Provide square to round adapters where required for connection to round ducts.
- C. Provide integral balancing dampers for diffusers, and grilles and registers where duct manual balancing dampers are not shown or specified.
- D. Linear Slot Diffusers:
 - 1. Coordinate connection plenum dimensions with linear slot final dimensions to conform with manufacturer's recommendations, or as indicated. Total and active lengths as noted on drawings. Blank off unused sections. Coordinate frame type with Architect.
 - 2. Paint surfaces visible behind air outlets and inlets, including blank-off sections, matte black unless otherwise called for on drawings.

END OF SECTION

SECTION 23 81 26
SMALL SPLIT SYSTEM AND UNITARY HVAC EQUIPMENT

SECTION 23 81 26 - SMALL SPLIT SYSTEM AND UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Materials, installation, and testing of:
 - 1. Ductless Split Systems - Cooling Only
 - 2. Split System Condensing Unit
 - 3. Split System Indoor Fan Coil Unit
 - 4. Gas Fired Furnace, High Efficiency
 - 5. Accessory Equipment

1.2 RELATED SECTIONS

- A. Contents of Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Efficiency ratings, cooling/heating performance, fan performance, sound performance to meet or exceed Basis of Design as scheduled on Drawings.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Refrigeration compressor(s): 5-year warranty.
 - 2. Furnace heat exchanger: 5-year warranty.

PART 2 - PRODUCTS

2.1 DUCTLESS SPLIT SYSTEMS - COOLING ONLY

- A. Manufacturers:
 - 1. Mitsubishi
 - 2. Sanyo
 - 3. Daikin Applied
 - 4. Friedrich
 - 5. Fujitsu
- B. Description: Self-contained, matched factory-engineered and assembled. Pre-wired indoor and outdoor units. UL/ETL listed.

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- C. Outdoor Unit:
1. Self contained, consisting of cabinet, compressor system, condenser fan matched to indoor unit.
 2. Cabinet: Fabricated of galvanized steel, bonderized, and finished with powder coated baked enamel.
 3. Refrigerant System:
 - a. HFC refrigerant or other refrigerant with zero ozone depletion potential (ODP).
 - b. Compressor: To be inverter driven, hermetic rotary type.
 4. Air System:
 - a. Fan: Propeller Type with one direct drive, inverter driven, variable speed motor.
 - b. Motor: Premium efficiency with inherent protection, permanently lubricated bearings and variable speed drive compatible.
 - c. Coil: Copper tubes and aluminum fins, coated for corrosion protection.
 5. Controls: Single source for both indoor and outdoor units, with low/high pressure switch.
- D. Indoor Unit(s):
1. Self contained wall mounted, ceiling mounted or recessed ceiling mounted evaporator unit(s) as shown on Drawings, matched to outdoor unit.
 2. Cabinet:
 - a. Non-flammable, high impact polymer with a white finish.
 - b. Power Source: To be a single point power connection or sub-fed from outdoor condensing unit.
 3. Refrigeration System: HFC refrigerant or other refrigerant with zero ozone depletion potential (ODP).
 4. Air System:
 - a. Fan: An assembly with one or two inline fan(s) with a single direct drive motor.
 - b. Filter: Polypropylene, furnished with the unit, removable and washable.
 - c. Coil: Direct expansion type with copper tubes mechanically bonded into aluminum fins.
 5. Condensate Drain:
 - a. Provide drain pan sloped to drain away from unit. Drain pan with a single drain connection.
 - b. Condensate pump kit provided with unit.
 - c. Secondary drain pan; Condensate overflow shut-off float switch and external alarm.
 6. Controls: Wired thermostat. Control to be integral with unit.

2.2 SPLIT SYSTEM CONDENSING UNIT

- A. Manufacturers:
1. Bryant
 2. Trane
 3. York
 4. Rheem
 5. Luxaire
 6. Lennox International
 7. Or approved equivalent.
- B. Description: Cooling operation, Energy Star labeled. Unit matched to indoor evaporator fan unit, coil, furnace, low ambient operation to 40 degrees F, or vibration isolators.
- C. Cabinet: Fabricated of galvanized steel and finished with powder coated baked enamel with Coastal Coating for corrosion resistance or Hail Guard.
- D. Refrigeration System:
1. HFC Refrigerant or other refrigerant with zero ozone depletion potential (ODP).

SECTION 23 81 26
SMALL SPLIT SYSTEM AND UNITARY HVAC EQUIPMENT

2. Hermetically sealed compressor, high efficiency, 2-stage operation, variable speed compressor, integral high/low pressure and temperature protection, liquid line filter dryer.
3. Options:
 - a. Long line accessory kit.
 - b. Solenoid valve.
 - c. Crankcase heater.
- E. Condenser Air System:
 1. Condenser Fan: Propeller type with direct drive motor, low sound generator, variable speed condenser fan.
 2. Condenser Fan Motor: Premium efficiency, permanently lubricated, totally enclosed with built-in current and thermal overload protection.
 3. Condenser Coil: Copper tubes mechanically bonded into aluminum fins.
 - a. Provide corrosion protection coating.
 - b. Provide Hail Guard.
- F. Condensate: Collection in galvanized steel drain pan sloped to drain away from the unit.
- G. Controls: Completely internally wired, microprocessor, high and low pressure cutouts, contractors and internal overload protection on all motors. Provide low ambient operation to 40 degrees F outside to maintain condensing temperature on part load operation. Provide anti-short cycle timer and time delay between compressor operation.

2.3 SPLIT SYSTEM INDOOR FAN COIL UNIT

- A. Manufacturers:
 1. Trane
 2. York
 3. Greenheck
 4. International Environmental
 5. Or approved equivalent.
- B. Indoor fan unit matched to outdoor condensing unit. Self-contained, packaged, factory-assembled, pre-wired unit with direct expansion evaporator coil, cabinet supply fan, filter housing and controls. Accessories, economizer assembly, etc. as scheduled and shown on Drawings.
- C. Components:
 1. Steel cabinet with baked enamel finish; minimum 1/2-inch thick, 1-1/2# liner with cleanable facing or solid interior metal panel, filter housing suitable for 2-inch thick filter. Easily removed access panels.
 2. Economizer/Mixing Box with damper actuator.
- D. Refrigeration System: HFC Refrigerant or other refrigerant with zero ozone depletion potential (ODP).
- E. Air System:
 1. Supply Fan (Evaporator Fan): centrifugal multi-speed direct drive, ECM motor drive, or V-belt with internal vibration isolation.
 2. Evaporator Motor: Premium efficiency with permanently lubricated bearings thermal overload protection. Provide optional high static motor.
 3. Evaporator Coil: Seamless copper tubes expanded into aluminum fins. Galvanized or polymer drain pan sloped in all directions.
 4. Filter: MERV 8, 2-inch thick, pleated, throw-away.
 5. Supplemental Heat Coil:
 - a. Electric Heat Coil: UL Listed with helix wound bare nichrome wire heating elements. Heat output and staging as scheduled. Power usage per stage is not to exceed 5 kilowatts. Staging of coil heat internally controlled.
- F. Condensate:
 1. Condensate pump kit.

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- 2. Secondary drain pan; condensate overflow shut-off float switch and external alarm.
- G. Controls: Factory-wired to internal terminal strip or board for connection to programmable thermostat.
- H. Electrical: Furnish magnetic contactors. Arrange for single point electrical connection. Provide all associated field wiring.

2.4 GAS FIRED FURNACE, HIGH EFFICIENCY

- A. Manufacturers:
 - 1. Lennox International
 - 2. Bryant
 - 3. Trane
 - 4. Carrier
 - 5. Comfortmaker
 - 6. Or approved equivalent.
- B. Self-contained, packaged, factory-assembled, pre-wired unit with direct expansion-evaporator coil, integral or matched section to furnace, cabinet, supply fan, heating element, controls, air filter housing, and wired for single point connection. Unit to be Energy Star labeled.
- C. Components:
 - 1. Cabinet: Steel with baked enamel finish; minimum 1/2-inch thick, 1-1/2# liner with cleanable facing. Easily removed access panels. Filter housing suitable for 2-inch thick filter.
 - 2. Burner: Forced draft blower with SiN hot surface ignition system.
 - 3. Provide burner converted to liquid petroleum gas.
 - 4. Provide concentric vent termination kit for roof or wall.
 - 5. Heat Exchanger: Constructed of heavy gauge aluminized steel or stainless steel.
- D. Refrigeration System: HFC Refrigerant or other refrigerant with zero ozone depletion potential (ODP).
- E. Air System:
 - 1. Supply Fan: Forward curve direct drive upflow, downflow, horizontal, or convertible horizontal/vertical.
 - 2. Supply Fan Motor: Single speed, Multi-speed, or ECM variable speed with fan speed optimization control, premium efficiency.
 - 3. Filter: MERV 8, two-inch thick, pleated, throw-away.
 - 4. Evaporator Coil (A-Frame Cooling Coil):
 - a. Direct expansion with seamless copper tubes expanded into aluminum fins.
 - b. Integral galvanized or polymer drain pan sloped in all directions, with insulation.
 - c. Drain pan overflow connection.
 - d. AHRI certified.
- F. Condensate Drain:
 - 1. Condensate pump kit.
 - 2. Secondary drain pan; Condensate overflow shut-off float switch and external alarm.
- G. Controls: Modulate gas flow to optimize fuel efficiency and maintain temperature set point, variable speed fan control, full combustion control, factory mounted, wired, and tested in the equipment.

2.5 ACCESSORY EQUIPMENT

- A. Economizer Damper Units: Steel cabinet with baked enamel finish, easily removed and secured access doors, glass fiber insulation.
 - 1. Dampers: Formed steel with nylon bearings and gaskets. Low leakage per local code.

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2. Damper Operator: 24 volt, three position spring return motor with adjustable minimum position switch.
3. Controls: Discharge air thermostat, adjustable outdoor air enthalpy control, return air.
4. Control Wiring: Provide wiring harness consisting of control board with relays, wiring harness, transformer, and hardware.
- B. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage, with following features:
 1. Thermostat Display:
 - a. Time of Day.
 - b. Actual Room Temperature.
 - c. Programmed Temperature.
 - d. Programmed Time.
 - e. Duration of Timed Override.
 - f. Day of Week.
 - g. System mode indication: Heating, cooling, fan auto, off, and on, auto or on, off.
 2. System selector switch (heat-off-cool) and fan control switch (auto-on).
 3. Automatic switching from heating to cooling.
 4. Preferential rate control to minimize overshoot and deviation from setpoint.
 5. Set-up for four separate temperatures per day.
 6. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 7. Short cycle protection.
 8. Programming based on weekdays, Saturday, and Sunday.
 9. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan auto-on.
 10. Battery replacement without program loss.
- C. Condensate Drain Pump: Provide condensate drain pump and float switch, powered from each unit, and wire to shut down unit on condensate overflow. Provide a UL listed float switch, Water Gard Electronic Condensation Control System as manufactured by Water Gard Inc., with magnetic, weighted, or clip-on sensor assembly, power transformer powered from unit, LED remote warning light, push button reset, and emergency shut off of unit on overflow.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install with required clearances and access for maintenance.
- B. Install factory furnished devices for field installation.
- C. Inspect for and remove shipping bolts, blocks and tie-down straps.
- D. After energizing units: Test units for proper fan rotation. Test and adjust controls and internal safeties. Replace malfunctioning units and retest.
- E. Thoroughly clean exposed portions of equipment. Install new filters prior to final test and balance and again prior to final acceptance.
- F. Provide vibration isolation: As scheduled.
- G. Provide seismic restraint.
- H. Condensate drain per manufacturer's piping diagram.
- I. Condensate piped to indirect waste connection; cleanouts at changes of direction; sized and sloped to drain per Code. Secondary drain routed to visible location.
- J. Shut-off/hose kits for all hydronic connections.

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SMALL SPLIT SYSTEM AND UNITARY HVAC EQUIPMENT

3.2 ACCESSORY EQUIPMENT INSTALLATION

- A. Maintain code required separation between outside air intake and plumbing vents and exhaust fan discharge.

END OF SECTION

SECTION 23 82 00
TERMINAL HEAT TRANSFER EQUIPMENT

SECTION 23 82 00 - TERMINAL HEAT TRANSFER EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Electric Wall Heaters

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as outlined in Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 ELECTRIC WALL HEATERS

- A. Manufacturers:
 - 1. Trane
 - 2. Markel
 - 3. Qmark
 - 4. Chromalox
 - 5. Indeeco
- B. Description: Wall mounted forced air unit heater, including enclosure for recessed mounting, fan and motor, heating elements and wall box. UL listed and wired per NEC.
- C. Cabinet: 20 gauge zinc coated steel, 16 gauge painted exterior grille.
- D. Fan and Motor: Propeller type fan, totally enclosed motor with permanently lubricated bearings and thermal overload protection, vandal proof.
- E. Heating Element: Sealed tubular type with finned heating elements, manual reset thermal limit safety switch, fan purge limit to dissipate residual heat on heater shutdown.
- F. Control:
 - 1. Built-in thermostat with accessible disconnect switch.

SECTION 23 82 00
TERMINAL HEAT TRANSFER EQUIPMENT

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways. Check each piece of equipment for defects, verifying that items function properly and that adjustments have been made.
- B. Prior to acceptance, thoroughly clean exposed portions of terminal heat transfer equipment, remove shipping labels and traces of foreign substance. Touch up scratched surfaces of radiant panels with factory matching paint.

3.2 ELECTRIC WALL HEATERS INSTALLATION

- A. Damaged Coils: Make every effort to prevent damage to both built-up coils and coils of packaged equipment. Comb damaged coil fins to be straight.
- B. Install per manufacturer's instructions. Comply with NEC and UL listings.
- C. Install heaters in place with box trim flush with finished wall.
- D. Install thermostat as shown on drawings. Provide control wiring from thermostat to unit.

END OF SECTION

SECTION 26 00 00
ELECTRICAL BASIC REQUIREMENTS

SECTION 26 00 00 - ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 DESIGN-BUILD SUMMARY

- A. Work included in 26 00 00 applies to Division 26, Electrical work to provide materials, labor, tools, permits and incidentals to make electrical systems ready for Owner's use for proposed project.

1.2 DESIGN-BUILD INSTRUCTIONS

- A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete electrical power, lighting and signal system for this project.
- B. Alternates to this Document may be offered as a separate proposal.
- C. Bidder to submit the following information with the Proposal:
 - 1. Preliminary schematic drawing indicating power distribution system (one-line diagram) to include proposed system capacity and expansion capacity, expected available fault current at the service equipment, fault duty ratings of proposed equipment, load survey and maximum voltage drop at distribution equipment.
 - 2. Description of lighting system, indicating luminaire types and manufacturer and method of control.
 - 3. List of wiring materials proposed for systems which are applicable to this project, e.g., switchgear, panels, motor control centers, transformers, generators and transfer switches, life safety and signal system equipment, and the like.
 - 4. Any other information which the bidder considers pertinent in evaluating the proposal.

1.3 DESIGN-BUILD APPROACH

- A. Use this Specification for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.
- B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by Authority Having Jurisdiction (AHJ).
- C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work. Verify the feasibility of reuse of all existing systems and equipment and replace as necessary.

1.4 DESIGN-BUILD CRITERIA/CALCULATIONS

- A. Related Work Specified Elsewhere: Contents of Section apply to Division 26 specifications. Requirements of Section are a minimum for Division 26 Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.
- B. Design Criteria:
 - 1. Base Service:
 - a. 480 volt, 3 phase, 4 wire
 - 2. Service Loads: Calculate service sizes. Utilize code acceptable diversity factors as allowed by code.
 - 3. Facade Lighting:
 - a. Where new exterior door is installed provide surface mounted LED wall pack above new exterior door to match existing.
 - 4. Interior Lighting:
 - a. Provide LED light fixtures to maintain IES recommended footcandles each space type at locations as shown in Architectural plans with controls as required per Oregon Energy Efficiency Specialty Code. Color rendering index (CRI) is to be a minimum of 80. Color temperature is to

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be 4000K. Provide socket-type replaceable lamps whenever possible.

- 1) Fitness 101: 8-foot recessed linear luminaires.
 - 2) Lockers 112: 6-inch recessed downlights and 4-foot linear recessed luminaires suitable for damp locations.
 - 3) Turnout Dry Room 114: 8-foot recessed linear luminaires.
 - 4) Classroom 115: 8-foot recessed linear luminaires.
 - 5) Apparatus Bay 117: 14-inch round pendant suitable for wet locations.
 - 6) Workshop: 8-foot recessed linear luminaires.
 - 7) Laundry: 8-foot recessed linear luminaires.
 - 8) Other spaces: Light fixtures as shown in Architectural plans or existing to remain.
5. Receptacles:
- a. Fitness 101: 120V duplex receptacles, pendant and on walls, as necessary to serve Owner furnished exercise equipment.
 - b. Lockers 112: Provide (1) 120V GFCI duplex receptacle above each sink.
 - c. Workshop 113: Provide (1) 120V duplex receptacles on walls spaces every 6 feet o.c.
 - d. Turnout Dry Room 114: Provide (1) 120V duplex receptacle at each wall.
 - e. Classroom 115:
 - 1) Provide 120V duplex receptacles on walls spaced every 12 feet o.c.
 - 2) Relocate Projector receptacle as necessary to new Projector location.
 - 3) Provide above counter duplex receptacle and dedicated 20A circuit for each of (4) microwaves at counter.
 - 4) Provide above counter duplex receptacle and dedicated 20A circuit for coffee maker at counter.
 - f. Demonstrations 116: Provide 120V duplex receptacles on walls spaced every 12 feet o.c.
 - g. Apparatus Bay 117: Provide surface mounted 120V GFCI duplex receptacles on walls spaced every 12 feet o.c. at 48-inches above finished floor.
 - h. Laundry 118: Provide receptacles for (2) salvaged washers and (1) salvaged dryer. Provide (1) addition 120V GFCI receptacle at east wall.
 - i. Mezzanine: Provide (1) 120V duplex receptacles on walls spaced every 12 feet o.c.
 - j. Other spaces: Receptacles as shown in Architectural plans or existing to remain.
6. Lighting:
- a. Provide luminaires, branch circuiting and switching complete per Oregon State Energy Efficiency Code.
7. HVAC:
- a. Provide complete electrical connections to HVAC units as designed and installed by Contractor. Provide duplex receptacles to have a duplex receptacle within 25 feet of each unit weatherproof receptacles at exterior locations.
8. Turnout: Coordinate with Division 23 to provide timer switch and fan connection at this location.
9. Washrooms
- a. Provide luminaire, branch circuiting, ceiling mounted dual technology occupancy sensors, and line voltage switch at door.
 - b. Provide electrical connection to fan as provided by Division 23 Contractor.
 - c. Provide GFI receptacle, location as directed by Architect, including branch circuit wiring.

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- d. Provide electrical connections to water heaters.
- 10. Interior:
 - a. Lobby Areas and Corridors:
 - 1) Provide 15 footcandles maintained in the lobby and corridors. See Architectural Reflected Ceiling Plans for luminaire location and luminaire types. Provide additional luminaires as needed to provide the minimum 15 footcandles. Coordinate with Architect for location and spacing.
 - 2) Provide one 110 volt duplex convenience outlet spaced every 30 feet o.c. in the lobby, 50 feet o.c. in corridor areas.
 - 3) Provide emergency lighting of 1 footcandle average maintained throughout exit pathway.
- 11. Signal Systems:
 - a. Provide extension of telephone service lateral raceways and termination provision as required by serving telephone utility company.
 - b. Provide plywood telephone terminal boards with double duplex receptacles in the service room. Provide a ground strip with 6AWG ground conductor from the main distribution panel.
- C. Calculations:
 - 1. Submit calculations for lighting energy consumption using the State of Oregon energy forms.
 - 2. Submit service and feeder load data.
 - 3. Submit fault duty calculations for entire electrical distribution system.
 - 4. Submit computer generated point-by-point calculation of parking lot lighting.
 - 5. Submit lighting level calculations.

1.5 SECTION INCLUDES

- A. Work included in 26 00 00, Electrical Basic Requirements applies to Division 26, Electrical work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electrical systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.6 RELATED SECTIONS

- A. Contents of Section applies to Division 26, Electrical Contract Documents.
- B. Related Work:

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1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.7 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, individual Division 26, Electrical Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 1. State of Oregon:
 - a. OAR - Oregon Administrative Rules
 - b. 2023 OESC - Oregon Electrical Specialty Code
 - c. 2022 OFC - Oregon Fire Code
 - d. 2022 OMSC - Oregon Mechanical Specialty Code
 - e. 2023 OPSC - Oregon Plumbing Specialty Code
 - f. 2022 OSSC - Oregon Structural Specialty Code
 - g. 2021 OEESC - Oregon Energy Efficiency Specialty Code
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act
 2. ADA - Americans with Disabilities Act
 3. ANSI - American National Standards Institute
 4. APWA - American Public Works Association
 5. ASCE - American Society of Civil Engineers
 6. ASHRAE Guideline 0, the Commissioning Process
 7. ASTM - ASTM International
 8. CFR - Code of Federal Regulations
 9. EPA - Environmental Protection Agency
 10. ETL - Electrical Testing Laboratories
 11. FCC - Federal Communications Commission
 12. FM - FM Global
 13. IBC - International Building Code
 14. IEC - International Electrotechnical Commission
 15. IEEE - Institute of Electrical and Electronics Engineers
 16. IES - Illuminating Engineering Society
 17. ISO - International Organization for Standardization
 18. MSS - Manufacturers Standardization Society
 19. NEC - National Electric Code
 20. NECA - National Electrical Contractors Association
 21. NEMA - National Electrical Manufacturers Association
 22. NETA - National Electrical Testing Association
 23. NFPA - National Fire Protection Association
 24. OSHA - Occupational Safety and Health Administration
 25. UL - Underwriters Laboratories Inc.
- D. See Division 26, Electrical individual Sections for additional references.

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1.8 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as individual Division 26, Electrical Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 - 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 - 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail or posted to ftp site. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Provide a table of contents identifying the products being submitted for each specification section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
 - a. Provide separate submittals for power system study (per Specification Section 26 05 73) and electrical equipment (for example, switchboards and panelboards).
 - b. Provide separate submittals for lighting control cutsheets, and for lighting control shop drawings.
 - 3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 26, Electrical Sections.
 - 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 26, Electrical specification Sections for specific items required in product data submittal outside of these requirements.
 - c. See Division 26, Electrical individual Sections for additional submittal requirements outside of these requirements.
 - 5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 - 6. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate

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manufacturer's installation and support requirements to meet ASCE 7-16 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.

7. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26, Electrical Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals. Electric motors are supplied and installed by Division 23 unless otherwise specified. During shop drawing stage of the project, verify correct disconnect sizes, conductor sizes, etc., and bring any discrepancies to the attention of the Mechanical trade. Be responsible for any modifications to electrical equipment or installations as a result of equipment incompatibility discovered after shop drawing review.
8. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
9. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any product marked "or approved equivalent," a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
10. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 26, Electrical specification Sections for additional requirements for shop drawings outside of these requirements.
 - a. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
11. Samples: Provide samples when requested by individual Sections.
12. Resubmission Requirements:
 - a. Make corrections or changes in submittals as required in response to Engineer's comments. Provide a cover letter with resubmittal that includes responses to each of the Engineer's submittal review comments and identifies changes in the resubmittal. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates "no exception taken" or "make corrections noted."
 - 2) When submitting drawings for Engineer's re-review, clearly indicate changes on drawings and cloud any revisions. Submit a list describing each change.
13. Operation and Maintenance Manuals, Owner's Instructions:

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- a. Submit, at one time, one bound copy and electronic files (native/searchable PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment.
 - 3) Include Warranty per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
 - 4) Include product certificates of warranties and guarantees.
 - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 6) Include commissioning reports.
 - 7) Include copy of startup and test reports specific to each piece of equipment.
 - 8) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
 - b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 26 00 00, Electrical Basic Requirements, Demonstration.
 - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
14. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed electrical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project on Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit Model and drawings upon substantial completion.
 - d. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written

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Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.

- e. Record drawings solely referencing field orders, supplemental instructions, etc. without any revision markups based on the change responses are not acceptable.
- f. See Division 26, Electrical individual Sections for additional items to include in record drawings.

1.9 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Making, supervising, or directing the making of an electrical installation which does not meet minimum safety standards is not allowed.
- G. Except as authorized by the Authority Having Jurisdiction, do not remove, transfer, alter or otherwise tamper with an inspection permit, label, tag or other indicia of inspection placed on or at an electrical job site, electrical installation or electrical product.

1.10 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, lights, cable tray and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of

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- influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
 - C. Verify in field exact size, location, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
 - D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.
- 1.12 OWNER-FURNISHED PRODUCTS
- A. Owner will furnish products as indicated within individual Division 26, Electrical Sections or as noted on Drawings. The Work includes providing support systems to receive Owner's equipment and making all associated electrical connections.
 - 1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
 - 2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
 - 3. After delivery, Owner will inspect delivered items for damage. Contractor is to be present for and assist in Owner's inspection.
 - 4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
 - 5. Contractor will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Owner.
 - 6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products.
 - 7. Using Owner-furnished earliest possible delivery dates, Contractor is to incorporate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
 - 8. Contractor is to review Shop Drawings, Product Data, and Samples and return them to Engineer noting discrepancies or anticipated problems in use of product.
 - 9. Contractor is responsible for receiving, unloading, handling, and storing Owner-furnished items at arrival to Project site.
 - 10. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
 - 11. If Owner-furnished items are damaged as a result of the Contractor's operations, Contractor is to repair or replace at no additional cost to Owner.
 - 12. Contractor is to install and otherwise incorporate Owner-furnished items into the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:

SECTION 26 00 00
ELECTRICAL BASIC REQUIREMENTS

1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 26, Electrical Sections. In the absence of specific requirements, comply with the following:
 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum of 24-inch by 24-inch.
 - b. Wall access panels to be minimum of 12-inch by 12-inch.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Milcor, Elmdor, Acudor, or approved equivalent.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Temporary Power:
 1. Design of temporary power for construction is the responsibility of the Contractor. Remove temporary power prior to completion of Project.
- E. Earthwork:
 1. Confirm Earthwork requirements in Contract Documents. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

SECTION 26 00 00
ELECTRICAL BASIC REQUIREMENTS

- a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- F. Firestopping:
- 1. Confirm requirements in Division 07, Thermal and Moisture Protection. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- G. Plenums:
- 1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.
- H. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- I. Provide miscellaneous supports/metals required for installation of equipment and conduit.
- 3.2 SEISMIC CONTROL
- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 26 Electrical Sections.
 - B. General:
 - 1. Earthquake resistant designs for Electrical (Division 26) equipment and distribution, i.e. power distribution equipment, generators, UPS, etc. to conform to regulations of jurisdiction having authority.
 - 2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
 - 3. Provide stamped shop drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for conduit and equipment. Submit shop drawings along with equipment submittals.
 - 4. Provide stamped shop drawings from licensed Structural Engineer of seismic flexible joints for conduit crossing building expansion or seismic joints. Submit shop drawings along with seismic bracing details.
 - 5. Provide means to prohibit excessive motion of electrical equipment during earthquake.
- 3.3 REVIEW AND OBSERVATION
- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

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ELECTRICAL BASIC REQUIREMENTS

- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground conduit installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch:
 - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Electrical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the electrical systems are ready for final punch.
 - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements, and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
 - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.
 - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 - 4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages must state specific dates, hours and maximum durations, with outages kept to these specific dates, hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.
 - a. Organize work to minimize duration of power interruption.
 - b. Coordinate utility service outages with utility company.

3.5 CUTTING AND PATCHING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 - 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftspeople of each respective trade in conformance with appropriate Division of Work.

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ELECTRICAL BASIC REQUIREMENTS

3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
 2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bus duct and similar items until in service.

3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, and individual Division 26, Electrical Sections.
- B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Authorized Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.9 CLEANING

- A. Confirm Cleaning requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Upon completion of installation, thoroughly clean electrical equipment, removing dirt, debris, dust, temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

SECTION 26 00 00
ELECTRICAL BASIC REQUIREMENTS

3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Install equipment and fixtures in accordance with manufacturers' installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- D. Provide miscellaneous supports/metals required for installation of equipment.

3.11 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces (i.e., hangers, hanger rods, equipment stands, etc.) with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In Electrical Room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Conduit: Clean, primer coat and paint interior/exterior conduit exposed in public areas with two coats paint suitable for metallic surfaces. Color selected by Architect.
 - 6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. Coordinate locations/sizes of access panels with Architect prior to work.

3.13 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. It is the intent of these documents to provide necessary information and adjustments to electrical system required to meet code, and accommodate installation of new work.
 - 2. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
 - 3. Examination:
 - a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.

SECTION 26 00 00
ELECTRICAL BASIC REQUIREMENTS

- b. Verify that abandoned wiring and equipment serve only abandoned facilities.
 - c. Demolition drawings are based on casual field observation and existing record documents.
 - 1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
 - 2) Verify location and number of electrical outlets, luminaires, panels, etc. in field.
 - d. Report discrepancies to Architect before disturbing existing installation.
 - 1) Promptly notify Owner if utilities are found which are not shown on Drawings.
4. Execution:
- a. Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings or as noted in Specifications.
 - b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring, equipment, and luminaires, as encountered in removed or remodeled areas in existing construction affected by this work.
 - c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
 - d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
 - e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
 - f. Extend circuiting and devices in existing walls to be furred out.
 - g. Remove abandoned wiring to source of supply.
 - h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
 - i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
 - j. Disconnect and remove abandoned panelboards and distribution equipment.
 - k. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - l. Existing lighting which is to remain, leave luminaires in proper working order.
 - m. Repair adjacent construction and finishes damaged during demolition work.
 - n. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

3.14 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:

SECTION 26 00 00
ELECTRICAL BASIC REQUIREMENTS

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Cleaning
 - b. Operation and Maintenance Manuals
 - c. Training of Operating Personnel
 - d. Record Drawings
 - e. Warranty and Guaranty Certificates
 - f. Start-up/Test Document and Commissioning Reports

3.15 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Tests:
 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.16 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Electrical items were installed in accordance with manufacturers' recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.17 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

- A. Salvage the following equipment not being reused and return to Owner:
 1. Luminaires
 2. Panelboards
 3. Breakers
 4. Transformers
- B. Electrical equipment that cannot be salvaged for reuse, sell/give to recycling company. Recycle following excess, removed, or demolished electrical material:
 1. Copper or aluminum conductors, buses, and motor/transformer windings.
 2. Steel and aluminum from raceways, boxes, enclosures, and housings.
 3. Acrylic and glass from luminaire lenses/refractors.
- C. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.
- D. Confirm additional salvaged equipment and recycled materials in the Contract Documents.

END OF SECTION

**SECTION 26 05 09
EQUIPMENT WIRING**

SECTION 26 05 09 - EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Equipment connections, whether furnished by Owner or other Divisions of the Contract.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition:
 - 1. Verify mechanical and utilization equipment electrical characteristics with Drawings and equipment submittals prior to ordering equipment. Submit confirmation of this verification as a part of, or addendum to, the electrical product submittals.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials and Equipment for Equipment Wiring: As specified in individual Sections.

2.2 GENERAL

- A. Unless otherwise noted, the following voltage and phase characteristics apply to motors:
 - 1. 3/4 HP and Under: 120 volt, 1 phase.
 - 2. 1 HP and Less than 5 HP Loads: 480 volt, 3 phase.
 - 3. 5 HP and Over: 480 volt, 208 volt, or 240 volt, 3 phase.
- B. Safety Switches: Provide as required by OESC and as specified in Section 26 28 16, Enclosed Switches and Circuit Breakers.

**SECTION 26 05 09
EQUIPMENT WIRING**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to submittal of product data for electrical distribution equipment, obtain and examine product data and shop drawings for equipment furnished by the Owner and by other trades on the project. Update the schedule of equipment electrical connections accordingly, noting proper ratings for overcurrent devices, fuses, safety disconnect switches, conduit and wiring, and the like. As a minimum, this requirement applies to equipment furnished by Owner and equipment furnished under the following divisions of work under this contract:
 - 1. Division 08, Openings
 - 2. Division 11, Equipment
 - 3. Division 21, Fire Suppression
 - 4. Division 22, Plumbing
 - 5. Division 23, HVAC, Heating, Ventilating and Air Conditioning
 - 6. Division 27, Communications
 - 7. Division 28, Electronic Safety and Security

3.2 INSTALLATION

- A. Do not install unrelated electrical equipment or wiring on mechanical equipment without prior approval of Architect.
- B. Provide moisture tight equipment wiring and switches in ducts or plenums used for environmental air.
- C. Connect motor and appliance/utilization equipment complete from panel to motor/equipment as required by code.
- D. Install motor starters and controllers for equipment furnished by others.
- E. Appliance/Utilization Equipment:
 - 1. Provide appropriate cable and cord cap for final connection unless equipment is provided with same. Provide receptacle configured to receive cord cap.
 - 2. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering wiring devices and coverplates.
- F. Rolldown Doors:
 - 1. Provide control wiring between door controller, wall switch controller and limit switches for door.
 - 2. Door Release by Fire Alarm System: Coordinate with Division 28, Electronic Safety and Security requirements.
 - 3. Coordinate with Division 08, Openings and Drawing requirements.
- G. Residential and Commercial dryers:
 - 1. Provide interlocks to exhaust fan so that fan is running when dryer is in use.
 - 2. Coordinate with Division 11, Equipment, and Drawing requirements.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Division 01, General Requirements.

3.4 SYSTEMS STARTUP

- A. Provide field representative to prepare and start equipment.
 - 1. Test and correct for proper rotation of polyphase motors.
- B. Adjust for proper operation within manufacturer's published tolerances.
- C. Demonstrate proper operation of equipment to Owner's Authorized Representative.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Lugs and Pads
 - 2. Wires and Cables
 - 3. Splices
 - 4. Connectors

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Cable insulation test reports in project closeout documentation.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lugs and Pads:
 - 1. Anderson
 - 2. IlSCO
 - 3. Panduit
 - 4. Thomas & Betts
 - 5. 3M
 - 6. Or approved equivalent.
- B. Wires and Cables:
 - 1. General:
 - a. General Cable
 - b. Okonite
 - c. Southwire
 - d. Encore Wire
 - e. Or approved equivalent.
 - 2. Metal Clad Cable - Type MC:
 - a. Alflex

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LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- b. AFC
 - c. General Cable
 - d. Southwire
 - e. Encore Wire
 - f. Or approved equivalent.
- C. Splices:
- 1. Branch Circuit Splices:
 - a. Ideal
 - b. 3M Scotchlok
 - c. Uraseal, Inc.
 - d. Or approved equivalent.
 - 2. Feeder Splices:
 - a. Not allowed.
- D. Connectors:
- 1. Anderson Power Products
 - 2. Burndy
 - 3. IlSCO
 - 4. 3M
 - 5. Thomas & Betts
 - 6. Or approved equivalent.

2.2 LUGS AND PADS

- A. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.
- B. Copper Pads: Drilled and tapped for multiple conductor terminals.
- C. Lugs: Compression type for use with stranded branch circuit or control conductors; mechanical type for use with solid branch and feeder circuit conductors.

2.3 WIRES AND CABLES

- A. Building Wires:
 - 1. Copper: Soft-drawn with conductivity of not less than 98 percent IACS at 20 degrees C (68 degrees F). 600 volt rated throughout. Conductors 12 AWG and 10 AWG, solid or stranded. Conductors 8 AWG and larger, stranded. 12 AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THHN/THWN-2, THHN/THWN-2 above grade and XHHW-2 below grade, or XHHW-2 on roofs.
 - 2. Aluminum: Insulation type and rating to match copper wiring. Compact stranded. Aluminum Association 8000 (AA-8000) Series alloy conductor material built to ASTM B800, B801, and B836 specifications.
- B. Aluminum, 600 volt rated throughout. Conductors #1/0 AWG and larger, compact stranded. Aluminum Association 8000 (AA-8000) Series alloy conductor material built to ASTM B801 specifications. Connectors and terminations to be those listed by Underwriters Laboratories Standard 486-B and marked "AL7CU" for 60C and 75C rated circuits. Connections and terminations to be installed strictly in accordance with manufacturers recommendations.
- C. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.
- D. Color Code Conductors as Follows:

PHASE	208 VOLT WYE
A	Black
B	Red
C	Blue
Neutral	White
Ground	Green

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

Isolated Ground	Green w/yellow trace
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- E. MC Cable:
 - 1. Standard: High strength galvanized steel flexible armor or High strength aluminum flexible armor. Full length minimum size No. 12 copper ground wire, copper dual rated THHN/THWN-2, full length tape marker phase/circuit identification on cable armor. Short circuit throat insulators, mechanical compression termination.
- F. AC Cable (Armored Cable): Not allowed.
- G. NMB Cable: Not allowed.

2.4 SPLICES

- A. Branch Circuits: Twist on, high temperature, grounding type wing nuts.
 - 1. Ideal Industries Wing-Nut Twist-On Connectors.
 - 2. 3M Scotchlok Twist-On Wire Connectors.
- B. Feeders:
 - 1. Feeder splices not allowed.

2.5 CONNECTORS

- A. Split bolt connectors not allowed.
- B. Aluminum Cable Compression Connections:
 - 1. Provide UL-listed compression lugs that are marked AL7CU or AL9CU and have passed UL 486B or UL 486C testing procedures.
 - 2. Construction: Electro tin plated high conductivity aluminum. Connector marked with wire size, die index, color-coded and the proper number and location of crimps. Factory pre-filled with oxide inhibiting compound.
 - 3. Aluminum cable connection to aluminum bus bar: Use 2-hole aluminum compression lug and aluminum hardware.
 - 4. Aluminum cable connection to copper bus bar: Use 2-hole aluminum compression lug, plated steel hardware and Belleville washer.
 - 5. Aluminum cable connection to mechanical lugs and equipment identified as not suitable for aluminum conductor termination: Provide aluminum compression lug with stranded copper wire/cable pigtail. Equip lug compression body with insulating cover.
 - 6. Aluminum Termination Hardware:
 - a. Bolts: Anodized alloy 2023-T4 and conforming to ANSI B18.2.1 and to ASTM B211 or B221 chemical and mechanical property limits.
 - b. Nuts: Aluminum alloy 6061-T6 or 6262-T9 and conforming to ANSI B18.2.2.
 - c. Washers: Flat aluminum alloy Alclad 2024-T4, Type A plain, standard wide series conforming to ANSI B27.2. SAE or narrow series washers are not permitted.
- C. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 12 AWG through 8 AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install per manufacturer instructions and OESC.
- B. Field Quality Control:
 - 1. Test conductor insulation on feeders of 100 amp and greater for conformity with 1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below. Notify Architect if insulation resistance is less than 1

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megohm.

2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit test reports with project closeout documents.
3. Inspect and test in accordance with NETA Standard ATS, except Section 4.
4. Perform inspections and tests listed in NETA Standard ATS, Section 7.3.2.

3.2 LUGS AND PADS

- A. Thoroughly clean surfaces to remove all dirt, oil, grease, or paint.
- B. Use torque wrench to tighten per manufacturer's directions.

3.3 WIRES AND CABLES

- A. General:
 1. Do not install or handle thermoplastic insulated wire and cable in temperatures below -10 degrees C (14 degrees F). Do not handle thermoset insulated wire and cable in temperatures below -40 degrees C (-40 degrees F). All wire and cable must be acclimated to temperatures above freezing for no less than 24 hours prior to installation.
 2. Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
 3. Install conductors with care to avoid damage to insulation.
 4. Do not apply greater tension on conductors than recommended by manufacturer during installation.
 5. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
 6. Additional Requirements for Aluminum Conductors (If Permitted):
 - a. Equipment connected to aluminum conductors to be specifically approved for the purpose, and marked as such. Pay particular attention to refrigeration and similar equipment. Do not use aluminum wire to make connections to mechanical equipment.
 7. Conductor Size and Quantity:
 - a. Install no conductors smaller than 12 AWG unless otherwise shown.
 - b. Provide required conductors for a fully operable system.
 - c. Power Circuits: No. 12 AWG minimum, except as follows:
 - 1) No. 10 AWG for 20A, 120V circuits longer than 60-feet but not exceeding 89-feet.
 - 2) No. 8 AWG for 20A, 120V circuits longer than 90-feet but not exceeding 139-feet.
 - 3) Notify Engineer of 20A, 120V circuits exceeding 140-feet if not shown on Drawings.
 - d. When exact run lengths are determined for all branch circuits, and prior to installation of the conductors, ensure that the maximum voltage drop, based on 80 percent of the circuit protective device, does not exceed 3 percent. Increase wire size from No. 12 AWG, if necessary, to ensure that the 3 percent voltage drop is not exceeded.
 8. Provide dedicated neutrals (one neutral conductor for each phase conductor) in all 120V circuits.
- B. Conductors in Cabinets:
 1. Conductors and cables within panels and cabinets are to be made up in a clean and workmanlike manner.
 2. Cable and tree wires in panels and cabinets for power and control. Use plastic ties in panels and cabinets.

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LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

3. Tie and bundle feeder conductors in wireways of panelboards.
4. Hold conductors away from sharp metal edges.
- C. Homeruns:
 1. Do not change intent of branch circuit homeruns without approval. Homeruns for 20A branch circuits may be combined to a maximum of six current carrying conductors including neutral conductors in homeruns. Apply derating factors as required per NEC. Increase conductor size as needed.
 2. MC cable homeruns are not allowed.
- D. Identify wire and cable under the provisions of Section 26 05 53, Identification for Electrical Systems. Identify each conductor with its panel and circuit number as indicated.
- E. Exposed cable is not allowed.
- F. All cable must be run parallel or perpendicular to building lines and hidden from view when possible. Where installed in tray each power cable is to be identified with Lamacoid nametag engraved with identification of equipment being fed. Tag to be fastened to cable using tie-wraps. Provide nametag at each floor level.
- G. Do not install PVC jacketed cables in return air plenums, unless they are specially rated plenum cables.
- H. Use of MC Cable is limited to the following conditions. Installations that do not comply with the following conditions are to be removed and replaced with no additional expense to the Owner.
 1. 15 and 20 amp branch wiring where following conditions apply:
 - a. Where there is a suspended ceiling with accessible space above (example: suspended acoustic ceiling tile).
 - b. Use MC cable for final flexible connections from junction or outlet boxes to recessed fixtures. Do not use MC cables to loop between fixtures, except where it is not practical to provide conduit connections between boxes or where existing inaccessible ceilings prevent installation of conduit runs. Each individual luminaire is to be serviced by an individual cable drop from the associated junction box in the ceiling space. Maximum length 6-feet of MC cable. Luminaire drops secured to, and supported by, the building structure with nylon tie wraps. The use of the ceiling suspension system for support of any type of cabling is not permitted.
 - c. Use MC cable for branch circuit wiring and short home runs under 50-feet in length. Provide minimum of one 12 by 12 junction box per room. Connect junction boxes where required and provide homeruns using multi-circuit MC cable.
 - d. MC cable may be routed in the void space above hard lid ceilings, and routed within wall cavities, including below glazing, provided OESC requirements are otherwise met, and a minimum one 0.75-inch conduit is routed from nearest accessible ceiling space to inaccessible location, terminating in a j-box with blank faceplate, for future circuits.
 - e. Do not use in walls in areas where MC cable cannot be fished into the walls after construction is completed. For example, walls with glazing or solid beams overhead, partial height walls, etc.

3.4 SPLICES

- A. Make splices complete and promptly after wire installation. Provide single wire pigtails for luminaire and device connections. Wire nuts may be used for luminaire wire connections to single wire circuit conductor pigtails.
- B. Make splices for No. 8 and larger wires with mechanically applied pressure type connectors. Make all taped joints with Scotch 33+ or equal, applied in half-lap layers without stretching to deform. Uraseal splice kits are also acceptable through 250 KCMIL.
- C. Remove insulation using industry approved means and methods to ensure all conductors are free of damage upon completion.

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3.5 CONNECTORS

- A. Install to assure a solid and safe connection.
- B. Select hand twist connectors for wire size and install tightly on conductors.
- C. Install compression connectors using methods and tools recommended by the manufacturer.
- D. Do not install stranded conductors under screw terminals unless compression lugs are installed.
- E. Do not connect wiring without UL listed connectors that are listed for the purposes.
- F. Additional requirements for aluminum connectors :
 - 1. Use adequate precaution for the termination or splicing of aluminum conductors, including removal of insulation and separators, cleaning (wire brushing) of stranded conductors, and compatibility and installation of fittings.
 - 2. Use a UL listed joint compound, capable of penetrating the oxide film and preventing its reforming, for terminating or splicing all sizes of stranded aluminum conductors, unless the termination or splice is approved for use without compound and is so marked.
 - 3. Do not terminate or splice aluminum conductors in wet locations unless the termination or splice is adequately protected against corrosion.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Anchors, Threaded Rod, and Fasteners
 - 2. Support Channel, Hangers, and Supports
 - 3. Rooftop Conduit Supports

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
 - 2. Support systems to be supplied by a single manufacturer.
 - 3. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for code required pipe support, trapeze, equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
 - a. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. General: Provide conduit and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment and supports, anchorages and seismic restraints for conduit, cable tray and equipment are not shown on the Drawings, the Contractor is responsible for their design.
 - 2. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

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- B. Engineered Support Systems: The following support systems to be designed, detailed, and bear the seal of a professional engineer registered in the State of Oregon.
 - 1. Support frames such as conduit racks or stanchions for conduit and equipment which provide support from below.
 - 2. Equipment and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for conduits to support multiple conduits capable of supporting combined weight of support systems and system contents.
- D. Provide heavy-duty steel trapezes for piping to support multiple conduit capable of supporting combined weight of supported systems and system contents.
- E. Provide seismic restraint hangers and supports for conduit and equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Anchors, Threaded Rod, and Fasteners:
 - 1. Anchor It
 - 2. Epcon System
 - 3. Hilti-Hit System
 - 4. Power Fast System
 - 5. Or approved equivalent.
- B. Support Channel, Hangers, and Supports:
 - 1. B-Line
 - 2. Kindorf
 - 3. Superstrut
 - 4. Unistrut
 - 5. Or approved equivalent.
- C. Rooftop Conduit Supports:
 - 1. Cooper B-Line Dura-Block Rooftop Support Base
 - 2. Or approved equivalent.

2.2 ANCHORS, THREADED ROD, AND FASTENERS

- A. Anchors, Threaded Rod and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Concrete Inserts: Cast in concrete for support fasteners for loads up to 800-pounds.
- C. Anchors and Fasteners:
 - 1. Do not use powder-actuated anchors.
 - 2. Concrete Structural Elements: Use precast inserts or expansion anchors.
 - 3. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
 - 4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
 - 5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
 - 6. Solid Masonry Walls: Use expansion anchors.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood Elements: Use wood screws.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

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- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.3 SUPPORT CHANNEL, HANGERS, AND SUPPORTS

- A. Hangers and Supports - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
 - 1. Channel Material: Carbon steel.
 - 2. Coating: Hot dip galvanized.
- B. Pipe Straps: Two-hole galvanized or malleable iron.
- C. Luminaire Chain: Carbon steel with zinc plated finish. Rated to minimum 90-pound safe working load.
- D. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings that are necessary for completion of the project. The Contractor is responsible for their design.
 - 1. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- E. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- F. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- G. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.4 ROOFTOP CONDUIT SUPPORTS

- A. Curb base made of 100 percent recycled rubber and polyurethane prepolymer with a uniform load
- B. Capacity of 500 pounds per linear foot of support.
- C. UV resistant.
- D. Steel Frame: Steel, 14 gauge strut galvanized per ASTM A653 or 12 gauge strut galvanized per ASTM A653 for bridge series.
- E. Continuous block channel supports with 1-inch gaps to allow water flow, bridge channel supports, extendable height channel supports and elevated single conduit supports.
- F. Attaching Hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633 fastened directly into rubber material with weather resistant Type 12 lag screws.
- G. Provide load distribution plates when required for heavy loads.
- H. Finish: Black with safety yellow striping.
- I. Provide hot dipped galvanized components for items exposed to weather.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Fabrication - Miscellaneous Metals
 - 1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar

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devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.

2. Finishes:

- a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with one coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
- b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
- c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

3.2 ANCHORS, THREADED ROD, AND FASTENERS INSTALLATION

- A. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.
- B. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- D. Do not use supports or fastening devices to support other than one particular item.
- E. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.
- F. Provide seismic bracing per OSSC requirements.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. Use spring lock washers under fastener nuts for strut.
- I. Cutting and Drilling
 1. Do not drill or cut structural members without prior permission from Architect.

3.3 SUPPORT CHANNEL, HANGERS, AND SUPPORTS INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
- B. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.
- C. Verify mounting height of luminaires prior to installation when heights are not detailed.
- D. Install vertical support members for equipment and luminaires, straight and parallel to building walls.
- E. Install horizontal support members straight and parallel to ceilings or finished floor unless otherwise noted.
- F. Provide independent supports to structural member for luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over suspended ceilings.

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- G. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.
- H. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- I. Do not use supports or fastening devices to support other than one particular item.
- J. Support conduits within 18-inches of outlets, boxes, panels, cabinets and deflections unless more stringently required by OESC.
- K. Maximum distance between supports not to exceed 5 foot spacing unless otherwise required by OESC.
- L. Support flexible conduits and metal clad cable within 12-inches of outlets, boxes, panels, cabinets and deflections unless otherwise required by OESC.
- M. Maximum distance between supports for flexible conduits and metal clad cable not to exceed 48-inches spacing unless otherwise required by OESC.
- N. Maximum distance between supports for rigid PVC conduits unless otherwise required by OESC is as follows:
 - 1. 1/2-inch or 3/4-inch and 1-inch conduit, 3-feet apart.
 - 2. 1-1/4-inch or 1-1/2-inch and 2-inch conduit, 4-feet apart.
 - 3. 2-1/2-inch and 3-inch conduit, 5-feet apart.
 - 4. 4-inch and 5-inch conduit, 6-feet apart.
 - 5. 6-inch conduit, 7-feet apart.
- O. Maximum distance between supports for auxiliary gutters and wireways unless otherwise required by OESC is as follows:
 - 1. Sheet metal auxiliary gutters and wireways: 4-feet apart horizontally and 10-feet vertically.
 - 2. Non-metallic auxiliary gutters and wireways: 30-inches apart horizontally and 3-feet vertically.
- P. Install strut hangers as instructed by strut manufacturer. Suspend strut hangers as instructed by strut manufacturer for the load, with a maximum spacing of 8-feet on center and within 2-feet of outlet box, cabinet, junction box or other channel raceway termination unless otherwise required by OESC.
- Q. Coordinate routing of conduit racks with materials and equipment installed by other trades. Where conduit racks are exposed to view, coordinate location and installation with Architect for optimal appearance.
- R. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.
- S. Provide seismic bracing per OSSC requirements.
- T. Where service disconnects are mounted on building exterior, physically attach service disconnect to the building or structure served.
- U. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- V. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- W. Wet and Damp Locations:
 - 1. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1-inch off wall.

3.4 ROOFTOP CONDUIT SUPPORTS INSTALLATION

- A. Consult roofing manufacturer for roof membrane compression capacities. If necessary, provide a compatible sheet of roofing material (rubber pad) under rooftop support to disperse concentrated loads and add further membrane protection.
- B. Do not use supports that will void roof warranty.
- C. Install supports per manufacturer's instructions and recommendations.
- D. Use properly sized clamps to suit conduit sizes.
- E. Install supports for rooftop raceways to raise raceways a minimum of 7/8-inches above the roof structure unless otherwise noted.

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HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

END OF SECTION

SECTION 26 05 33
RACEWAYS

SECTION 26 05 33 - RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Rigid Metal Conduit (RMC)
 - 2. Electrical Metallic Tubing (EMT)
 - 3. Flexible Metal Conduit (FMC)
 - 4. Liquidtight Flexible Metal Conduit (LFMC)
 - 5. Conduit Fittings
- B. Provide a complete system of conduit and fittings, with associated couplings, connectors, and fittings, as shown on Drawings and described in these Specifications.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 29, Hangers and Supports for Electrical Systems and Equipment
 - 2. Section 26 05 34, Boxes

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.7 DEFINITIONS

- A. Raceway system is defined as consisting of conduit, tubing, duct, and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion/deflection fittings, and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Rigid Metal Conduit (RMC):
 - 1. Allied Tube & Conduit
 - 2. Beck Manufacturing Inc.

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RACEWAYS**

- 3. Picoma
 - 4. Wheatland Tube Company
 - 5. Or approved equivalent.
 - B. Electrical Metallic Tubing (EMT):
 - 1. Allied Tube & Conduit
 - 2. Beck Manufacturing WL
 - 3. Picoma
 - 4. Wheatland Tube Company
 - 5. Or approved equivalent.
 - C. Flexible Metal Conduit (FMC):
 - 1. AFC Cable Systems Inc.
 - 2. Electri-Flex Company
 - 3. International Metal Hose
 - 4. Or approved equivalent.
 - D. Liquidtight Flexible Metal Conduit (LFMC):
 - 1. AFC Cable Systems Inc.
 - 2. Electri-Flex Company
 - 3. International Metal Hose
 - 4. Or approved equivalent.
 - E. Conduit Fittings:
 - 1. Bushings:
 - a. Insulated Type for Threaded Raceway Without Factory Installed Plastic Throat Conductor Protection:
 - 1) Thomas & Betts 1222 Series
 - 2) O-Z Gedney B Series
 - 3) Or approved Equivalent.
 - 2. Raceway Connectors and Couplings:
 - a. Thomas & Betts Series
 - b. O-Z Gedney Series
 - c. Or approved Equivalent.
 - 3. Expansion/Deflection Fittings:
 - a. EMT: O-Z Gedney Type TX
 - b. RMC: O-Z Gedney Type AX
 - c. PVC: O-Z Gedney Type DX with PVC adapters
 - d. Or approved equivalent.
- 2.2 RIGID METAL CONDUIT (RMC)
- A. UL 6, ANSI C80.1. Hot dipped galvanized steel conduit after thread cutting.
 - 1. Fittings: NEMA FB2.10.
- 2.3 ELECTRICAL METALLIC TUBING (EMT)
- A. Description: UL 797, ANSI C80.3; steel galvanized tubing.
 - B. Fittings: NEMA FB 1; steel, compression type.
- 2.4 FLEXIBLE METAL CONDUIT (FMC)
- A. Description: UL 1, interlocked steel construction.
 - B. Fittings: NEMA FB 2.20.
- 2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)
- A. Description: UL 360, inner core made from spiral wound strip of heavy gauge, hot dipped galvanized low carbon steel. 3/4-inch through 1-1/4-inch trade sizes to have a square lock core and contain an integral bonding strip of copper. 1-1/2-inch and larger to have fully interlocked core. Jacket material to be moisture, oil, and sunlight resistant flexible PVC.
 - B. Fittings: NEMA FB 2.20.

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2.6 CONDUIT FITTINGS

- A. Bushings:
 - 1. Plastic insulated type for threaded raceway connectors without factory-installed plastic throat conductor protection lined, 105 degree C rated.
 - 2. Insulated grounding type for threaded raceway connectors.
- B. Raceway Connectors and Couplings:
 - 1. Steel connectors, couplings, and conduit bodies, hot-dip galvanized.
 - 2. Connector locknuts to be steel, with threads meeting ASTM tolerances. Locknuts to be hot-dip galvanized.
 - 3. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) to have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from raceway, the cable jacket or conductor insulation to bear only on plastic throat insert.
 - 4. All connectors to be plastic insulated, lined, and 105 degree C rated.
- C. Provide expansion/deflection fittings for EMT.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Finished Surfaces: Schedule raceway installation to avoid conflict with installed wall and ceiling surfaces. If unavoidable, coordinate work and repairs with Architect.
- B. Conduit Size:
 - 1. Minimum Size: 3/4-inch for power and control, unless otherwise noted. 3/4-inch for communication/data, unless otherwise noted. 3/4-inch for signal systems, unless otherwise noted.
- C. Provide two pull strings/tapes in empty conduits. Types:
 - 1. High-strength, stretch resistant, woven polyester. Factory lubricated to reduce burn-through.
 - 2. Branch Circuits and Low Voltage: 1/2-inch, 1,250-pound rated, Greenlee 4435, Mule Tape, Herculine, or approved equivalent.
 - 3. If fish tape is used for pulling line or low voltage wiring, fiberglass type to be used. Metal fish tapes not allowed.
 - 4. Secure pull string/tape with minimum 6-feet extended at each end.
 - 5. Install pull string/tape after conduit is joined and glue is dry.
 - 6. Provide caps on ends of empty conduit to be used in future.
 - 7. Label both ends of empty conduits with location of opposite end.
- D. Elbow for Low Energy Signal Systems: Use long radius factory ells where linking sections of raceway for installation of signal cable.
- E. When installing utility conduit, 6-inch or smaller, sweeps must be separated by a straight section of at least 5-feet in length and an initial horizontal straight section of at least 3-feet beginning from the vault.
- F. Verify that field measurements are as shown on Drawings.
- G. Plan locations of conduit runs in advance of the installation and coordinate with ductwork, plumbing, ceiling and wall construction in the same areas.
- H. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, and walls. Penetrations are acceptable only when the following occurs:
 - 1. Where shown on the Structural Drawings.
 - 2. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- I. Verify routing and termination locations of conduit prior to rough-in.
- J. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

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- K. Install raceways securely, in neat and workmanlike manner, as specified in NECA 1, Standard Practices for Good Workmanship in Electrical Construction.
- L. Duct proof all underground conduits to remove dirt and debris and ensure conduit is not obstructed, out-of-round, or collapsed. Utilize a wood test mandrel (or equivalent plastic/hard-rubber) configured for the conduit inside diameter.
- M. Install steel conduit as specified in NECA 101, Standard for Installing Steel Conduits.
- N. Install nonmetallic conduit in accordance with manufacturer's instructions.
- O. Inserts, anchors and sleeves.
 - 1. Coordinate location of inserts and anchor bolts for electrical systems prior to concrete pour.
 - 2. Coordinate location of sleeves with consideration for other building systems prior to concrete pour.
- P. Conduit Supports:
 - 1. Arrange supports to prevent misalignment during wiring installation.
 - 2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
 - 3. Group related conduits; support using conduit rack. Construct rack using steel channel. Provide space on each for 25 percent additional conduits.
 - 4. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 - 5. Do not attach conduit to ceiling support wires.
 - 6. Conduits shall be supported within 18" of outlets, boxes, panels, cabinets, and deflections
- Q. Flexible metal conduit length not-to-exceed 6-feet, 3-feet in concealed walls. Provide sufficient slack to reduce the effect of vibration.
- R. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more as shown on the drawings. Install seals on warm side of partition.
- S. Seal raceways stubbing up into electrical equipment. Plug raceways with conductors with duct-seal. Cap spare raceways and plug PVC raceway products with plastic plugs as made by Underground Products, or equal, shaped to fit snugly into the stubup.
- T. Seal raceways penetrating an exterior building wall to prevent moisture and vermin from entering into the electrical equipment.
- U. Use suitable caps on spare and empty conduits to protect installed conduit against entrance of dirt and moisture.
- V. Arrange conduit to maintain headroom and present neat appearance.
- W. Do not install conduits on surface of building exterior, along vapor barrier, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.
- X. Exposed conduits are permitted only in following areas:
 - 1. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
 - 2. Existing walls that are concrete or block construction.
 - 3. Where specifically noted on Drawings.
 - 4. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.
- Y. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.
- Z. Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
- AA. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- BB. Maintain adequate clearance between conduit and piping.
- CC. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F). 6-inches from heating ducts, or 3-inches away from waste or water lines.
- DD. Cut conduit square using saw or pipecutter; deburr cut ends.
- EE. Bring conduit to shoulder of fittings; fasten securely.

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- FF. Use conduit hubs or sealing locknuts to fasten conduit to cast boxes in damp and wet locations.
 - GG. Install no more than the equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.
 - HH. Use factory elbows or hydraulic one shot bender to fabricate elbows for bends in metal conduit larger than 2-inch size.
 - II. Avoid moisture traps.
 - JJ. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.
 - KK. Conduit Terminations for Signal Systems: Provide a plastic bushing on the end of conduit used for signal system wiring.
 - LL. Feeders: Do not combine or change feeder runs.
 - MM. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.
 - NN. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation and installer. A bushing shall be used where conduit enters a panel box.
- 3.2 RIGID METAL CONDUIT (RMC) INSTALLATION
- A. Outdoor Locations Above Grade: RMC.
 - B. Damp Locations: RMC.
 - C. In areas exposed to mechanical damage: RMC.
 - D. For security conduits installed exposed and subject to tampering: RMC.
- 3.3 ELECTRICAL METALLIC TUBING (EMT) INSTALLATION
- A. Dry Locations:
 - 1. Concealed: EMT.
 - 2. Exposed: EMT.
 - B. Dry, Protected: EMT.
- 3.4 FLEXIBLE METAL CONDUIT (FMC) INSTALLATION
- A. Dry Locations: Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.
 - B. Install 12-inch minimum slack loop on flexible metallic conduit.
- 3.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) INSTALLATION
- A. Use PVC coated liquidtight flexible metallic conduit for motors and equipment connections subject to movement or vibration and subjected to any of following conditions: Exterior location, moist or humid atmosphere, corrosive environments, water spray, oil, or grease.
 - B. Install 12-inch minimum slack loop on liquidtight flexible metallic conduit.
- 3.6 CONDUIT FITTINGS INSTALLATION
- A. Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal). Threadless connections are not permitted for RMC.
 - B. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
 - C. Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from overcurrent protection device to outlet.

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- D. Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2-inches in diameter.
- E. Use threaded type fittings in wet locations, hazardous locations, and damp or rain-exposed locations where conduit size is greater than 2-inches.
- F. Use PVC coated, threaded type fittings in corrosive environments.
- G. Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes that have feeders 60 amperes and greater.
- H. Condulets and Conduit Bodies:
 - 1. Do not use condulets and conduit bodies in conduits for signal wiring, in feeders 100 amp and larger, or for conductor splicing.
- I. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings, or walls.
- J. Expansion Joints:
 - 1. Provide conduits crossing expansion joints where cast in concrete with expansion-deflection fittings, installed per manufacturer's recommendations.
 - 2. Secure conduits 3-inches and larger to building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across joint installed per manufacturer's recommendations.
 - 3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inch and larger may be installed.
 - 4. Verify expansion/deflection requirements with Structural Engineer prior to installation.
- K. Seismic Joints:
 - 1. No conduits cast in concrete allowed to cross seismic joint.
 - 2. Provide conduits with junction boxes securely fastened on both sides of seismic joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that 15-inches is adequate for designed movement, and if not, increase this length as required.
 - 3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inches and larger may be installed.
- L. Provide rigid conduit coupling flush with surface of slab or wall for conduit stubbed in concrete slab or wall to serve electrical equipment or an outlet under table or to supply shop tool, etc. Provide plug where conduit is to be used in future.

END OF SECTION

SECTION 26 05 34
BOXES

SECTION 26 05 34 - BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Outlet Boxes
 - 2. Pull and Junction Boxes
 - 3. Box Extension Adapter
 - 4. Weatherproof Outlet Boxes
- B. Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts and other necessary components.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 33, Raceways
 - 2. Section 26 05 53, Identification for Electrical Systems

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Outlet Boxes:
 - 1. Hubbell
 - 2. Thomas & Betts
 - 3. Eaton/Crouse-Hinds
 - 4. Or approved equivalent.
- B. Pull and Junction Boxes:
 - 1. Eaton/Crouse-Hinds
 - 2. Hoffman
 - 3. Or approved equivalent.
- C. Box Extension Adapter:
 - 1. Hubbell
 - 2. Thomas & Betts

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BOXES

3. Eaton/Crouse-Hinds
 4. Or approved equivalent.
- D. Weatherproof Outlet Boxes:
1. Legrand (Pass & Seymour)
 2. Hubbell
 3. Thomas & Betts
 4. Eaton/Crouse-Hinds
 5. Intermatic
 6. Or approved equivalent.

2.2 OUTLET BOXES

- A. Luminaire Outlet: 4-inch octagonal box, 1-1/2-inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.
- B. Device Outlet: Installation of one or two devices at common location, minimum 4-inches square, minimum 1-1/2-inches deep for non-USB type devices. Installation of one or two devices at common locations, minimum 4-inches square, minimum 2-inches deep for USB type devices. Single- or two-gang flush device raised covers.
- C. Telecom Outlet: Provide 4-inches square, minimum 2-1/8-inch deep box with two-gang plaster ring.
- D. Multiple Devices: Three or more devices at common location. Install one-piece gang boxes with one-piece device cover. Install one device per gang.
- E. Masonry Boxes: Outlets in concrete.
- F. Construction: For interior locations, provide galvanized steel outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices. All surface mounted outlet boxes are to be drawn. Welded boxes are not acceptable.
- G. Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.
- H. Noise Control: Provide acoustic putty pad to back side of each outlet box installed in acoustic rated walls.

2.3 PULL AND JUNCTION BOXES

- A. Construction: Provide ANSI 61 gray polyester powder painted sheet steel junction and pull boxes, with screw-on covers; of type shape and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- B. Location:
 1. Provide junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
 2. Provide junction boxes and pull boxes to facilitate installation of conductors and limiting accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.

2.4 BOX EXTENSION ADAPTER

- A. Construction: Diecast aluminum.
- B. Location: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.

2.5 WEATHERPROOF OUTLET BOXES

- A. Construction: Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, NEMA 3R transparent plasticcast metal faceplate with spring-hinged waterproof cap suitably

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BOXES

configured for each application, including faceplate, gasket, blank plugs and corrosion proof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate locations of wall mounted wiring device boxes with architectural and structural floor plans prior to rough-in.
- B. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1, Standard Practice of Good Workmanship in Electrical Construction.
- C. Secure boxes rigidly to substrate upon which they are being mounted.
- D. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NEC. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
- E. Set wall mounted boxes at elevations to accommodate mounting heights shown on Architectural Elevations.
- F. Electrical boxes are shown on drawings in approximate locations unless dimensioned.
 - 1. Adjust box locations up to 10-feet if required to accommodate intended purpose.
- G. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.
- H. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- J. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12-inches of box.
- K. Box Color Coding and Marking: Reference Section 26 05 53, Identification for Electrical Systems.
- L. Adjust boxes to be parallel with building lines. Boxes not plumb to building lines are not acceptable.
- M. Install knockout closures in unused box openings.
- N. Clean interior of boxes to remove dust, debris, and other material.
- O. Clean exposed surfaces and restore finish.

3.2 OUTLET BOXES INSTALLATION

- A. Mount outlet boxes, unless otherwise required by ADA, or noted on Drawings, following distances above finished floor:
 - 1. Control Switches:
 - a. 48-inches to the top of outlet box.
 - b. 4-inches above top of backsplash at countertops/workstations, not to exceed 44-inches above finished floor to the top of outlet box, per ADA requirements.
 - 2. Receptacles:
 - a. 15-inches to the bottom of outlet box.
 - b. 4-inches above top of backsplash at countertops/workstations, not to exceed 44-inches above finished floor to the top of outlet box, per ADA requirements.
 - 3. Telecom Outlets:
 - a. Match height of adjacent receptacle.
 - b. 15-inches to the bottom of outlet box.
 - c. 4-inches above top of backsplash at countertops/workstations, not to exceed 44-inches above finished floor to the top of outlet box, per ADA standards.
 - 4. Other Outlets: As indicated in other sections of Specifications or as detailed on Drawings.

SECTION 26 05 34
BOXES

- B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.
- C. Flush Outlets in Insulated Spaces: Maintain integrity of insulation and vapor barrier.
- D. Coordinate electrical device locations and elevations (switches and receptacles) with architectural drawings to prevent mounting devices in mirrors, back splashes, and behind cabinets.
- E. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Adjacent boxes not aligned vertically to be adjusted at no additional cost to Owner.
- G. Use flush mounting outlet box in finished areas.
- H. Do not install flush mounting box back-to-back in walls; provide minimum 6-inches separation. Provide minimum 24-inches in acoustic rated walls.
- I. In acoustical walls, apply acoustic putty pad on outlet box prior to installation of acoustical blanket.
- J. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- K. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- L. Use adjustable steel channel fasteners for hung ceiling outlet box.
- M. Use gang box where more than one device is mounted together. Do not use sectional box.
- N. Use gang box with plaster ring for single device outlets.
- O. Adjust flush-mounting outlets to make front flush with finished wall material.

3.3 PULL AND JUNCTION BOXES INSTALLATION

- A. All pull boxes, junction boxes, and other enclosures shall be accessible without conflict from other equipment or trades.
- B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- C. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.
- D. Do not fasten boxes to ceiling support wires.
- E. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.4 BOX EXTENSION ADAPTER INSTALLATION

- A. Match material to box.
- B. Install gaskets at exterior and wet locations.

3.5 WEATHERPROOF OUTLET BOXES INSTALLATION

- A. Use cast outlet box in exterior locations exposed to weather and wet locations.
- B. Install gaskets.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Equipment Nameplates
 - 2. Device Labels
 - 3. Wire Markers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Manufacturer's standard products of categories and types required for each application as referenced in other Division 26, Electrical Sections. Where more than a single type is specified for application, provide single selection for each product category.
 - 3. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Equipment Nameplates:
 - 1. B & I Nameplates
 - 2. Intellicum
 - 3. JBR Associates
 - 4. Or approved equivalent.
- B. Device Labels:
 - 1. Kroy
 - 2. Brady
 - 3. Or approved equivalent.
- C. Wire Markers:

SECTION 26 05 53
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1. Brady
2. Panduit
3. Sumitomo
4. Or approved equivalent.

2.2 EQUIPMENT NAMEPLATES

- A. Engraved phenolic plastic, laminate, minimum 1/16-inch thick in the size indicated, with beveled edge border matching letter color. Federal specification LP-387A. All upper case letters in engraver standard letter style of the size and wording indicated. Provide with 2-mil adhesive backing. Embossed tape style labels are not acceptable.
- B. Color:
 1. Normal (Utility): White letters on black background.
 2. Life Safety/Critical (Emergency Systems): Black letters on orange background.
 3. Equipment Branch (Legally Required Standby Systems): Black letters on yellow background.
- C. Letter Size:
 1. Use 1/2-inch letters minimum for identifying major equipment and loads, including switchgear, switchboards, distribution panels, generators, automatic transfer switches, UPS, etc.
 2. Use 1/4-inch or 1/2-inch letters minimum for identifying panels, breakers, transformers, VFDs, disconnects, etc.
 3. Use 3/16-inch minimum for identifying source, voltage, current, phase, wire configurations, and short circuit current rating (SCCR).
- D. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- E. The Architect, Engineer, Commissioning Agent and Owner reserve the right to make modifications to the nameplates as necessary.
- F. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
- G. Locations:
 1. Switchgear, switchboards, sub-distribution switchboards, distribution panels, branch panels, transfer switches, UPS.
 2. Main breakers and distribution breakers in switchgear, switchboards, and distribution panels.
 3. Equipment including, but not limited to, motor controllers, disconnects, and VFDs.
 4. Low-voltage equipment enclosures including, but not limited to, fire alarm panels, access control panels, and lighting control panels.

2.3 DEVICE LABELS

- A. Extra strength, laminated adhesive tape with 3/16-inch black letters on clear background. Embossed tape/punch tape style labels are not acceptable.
- B. Receptacles: Indicate source panel and source circuits (e.g. xxx-xx).
- C. Wall Switches/Control Device Stations:
 1. Where controls are provided for remote lighting or power outlets, or where controls in same location serve different purposes or areas, such as corridor and outside, provide device label indicating function of each control device.
 2. Label the function of control devices where two or more are mounted in same location and control function may be unclear.
 3. Wall switches with engraved buttons do not require labeling.
- D. Junction Boxes: Label to show panel number, circuit, and voltage. In finished areas, utilize device label. In unfinished areas or above ceilings, use of permanent ink marker is acceptable.

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

- E. Panel and circuit designation written in permanent marker on the back of the plate and inside all back-boxes and junction boxes.

2.4 WIRE MARKERS

- A. Description: Vinyl-cloth self-adhesive or tubing type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection.
- C. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings and source panel.
- D. Control Circuits: control wire number indicated on schematic and interconnection diagrams on drawings or shop drawings.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate designations used on Drawings with equipment nameplates and device labels.
- B. Install nameplates and labels parallel to equipment lines.
- C. Identify empty conduit and boxes with intended use.
- D. Provide typewritten branch panel schedules with protective clear transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on Drawings.
- E. Where changes are made in existing panels, distribution boards, etc., provide new labeling and typewritten schedules to accurately reflect the changes.
- F. Provide color coded boxes as follows:
 - 1. Fire Alarm: Red.

3.2 EQUIPMENT NAMEPLATES

- A. Degrease and clean surfaces to receive nameplates.
- B. Secure equipment nameplates to equipment front using manufacturer adhesive backing or self-tapping stainless steel screws.
- C. Secure equipment nameplates to inside surface of door on panelboard that is recessed in finished locations.
- D. Distribution panels and branch panels to include name, source, voltage, current, phase, wire configuration, and short circuit current rating (SCCR).
- E. Disconnect switches and VFDs to include name, source, and circuit number.
- F. Provide nameplates for branch panelboards identifying name on front door. On inside of door provide nameplate as noted above.
- G. Provide a second label at branch panelboards listing the means of identification of branch circuit conductors. This identification legend to consist of the color code used for each voltage system (208Y/120V and 480Y/277V). Include identification of both voltage systems on each label, regardless of the voltage of the panelboard to which the label is affixed. Comply with requirements of NEC 210.5.
 - 1. See Specification Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables, for required conductor color code for this project.

3.3 DEVICE LABELS

- A. Reference General Installation Requirements above.
- B. Install per manufacturer's instructions and recommendations.
- C. Degrease and clean surfaces to receive labels.

3.4 WIRE MARKERS

- A. Reference General Installation Requirements above.
- B. Install per manufacturer's instructions and recommendations.

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

- C. Provide wire markers on each conductor for power, control, signalling and communications circuits.
- D. Where switches control remote lighting or power outlets, or where switches or outlets in the same location serve different purposes, such as light, power, intercom, etc. or different areas such as corridor and exterior, provide plates with 1/8-inch black letters indicating function of each switch or outlet. Also label the function of lighting switches where two or more are mounted in the same locations.

END OF SECTION

SECTION 26 05 73
ELECTRICAL DISTRIBUTION SYSTEM STUDIES

SECTION 26 05 73 - ELECTRICAL DISTRIBUTION SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Protective Devices
 - 2. Short Circuit Study
 - 3. Arc Flash Risk Assessment
 - 4. Arc Flash Labels

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 22 00, Low Voltage Transformers
 - 2. Section 26 24 16, Panelboards
 - 3. Section 26 28 00, Overcurrent Protective Devices
 - 4. Section 26 28 16, Enclosed Switches and Circuit Breakers

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - 2. IEEE 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
 - 3. IEEE 1584, Guide for Performing Arc Flash Calculation.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition provide:
 - 1. Power system studies required under this Section with submittals for electrical equipment, including overcurrent protective devices.
 - 2. Electrical equipment ordered prior to submittal of power system studies are not compliant with these specifications, and are subject to removal and replacement at no cost to Owner where not in compliance with Code and Contract Documents for selective coordination.
 - a. Provide written verification with Stamp or Seal and signature of preparing Engineer.
 - 3. Provide samples of NFPA 70E compliant arc flash hazard labeling for electrical equipment.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Study Preparer Qualifications: Qualified engineer of switchgear manufacturer or approved professional engineer.
 - a. Experienced in preparation of studies of similar type and magnitude.
 - b. Familiar with software analysis products specified.

SECTION 26 05 73
ELECTRICAL DISTRIBUTION SYSTEM STUDIES

2. Computer Software for Study Preparation: Use latest edition of commercially available software utilizing specified methodologies.
 - a. Acceptable Software Products:
 - 1) EasyPower
 - 2) Operation Technology, Inc; ETAP.
 - 3) SKM Systems Analysis, Inc; Power Tools for Windows.
 - b. The above manufacturers are known to be acceptable for study purposes. At the completion of the study, provide an electronic EasyPower file of the project to the Owner/Engineer. The file is to include all files required to edit and evaluate the electronic model, including libraries, one-lines, scenarios, TCC curves and all reports.
3. Contractor Responsibility: Provide project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, actual circuit lengths and available fault currents from utility. Provide information in a timely matter to allow studies to be completed prior to release of equipment.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Analyze specific electrical and utilization equipment (according to NEC definition), actual protective devices to be used, and actual feeder lengths to be installed.
 1. Scope of Studies: New distribution wiring and equipment, from primary source to buses, branch circuit panelboards and equipment rated 50A or larger at utilization voltage.
 2. Primary Source, for Purposes of Studies: Utility company transformer secondary.
 3. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
 4. Report: State methodology and rationale employed in making each type of calculation; identify computer software package(s) used.
- B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with electrical equipment and wiring to be protected by protective devices; identify nodes on diagrams for reference on report that includes:
 1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at main switchboard bus and downstream devices containing protective devices.
 2. Breaker and fuse ratings.
 3. Generator kW and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 4. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 5. Identification of each bus, with voltage.
 6. Conduit materials, feeder sizes, actual lengths, and X/R ratios.

2.2 PROTECTIVE DEVICES

- A. Provide protective devices of ratings and settings as required so that protective device closest to fault will open first.
- B. Replace existing protective devices to achieve specified performance.
- C. Analyze and determine ratings and settings of protective devices to minimize damage caused by fault and so that protective device closest to fault will open first.

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ELECTRICAL DISTRIBUTION SYSTEM STUDIES

1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
 2. Motors with Solid-State Protective Modules: Select settings for best possible motor protection, taking into consideration actual installed motor torque and current and thermal characteristics.
 3. Identify any equipment, both new and existing, that is underrated.
 4. Identify specified protective devices that will not achieve required protection or coordination but with minor changes can be made to do so; provide such modified devices at no additional cost to Owner and identify them on submittals as "revised in accordance with Protective Device Coordination Study"; minor changes include different trip sizes in same frame, time curve characteristics of induction relays, CT ranges, etc.
 5. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve change to contract sum.
 6. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.
 7. Do not order, furnish, or install protective devices that do not meet performance requirements unless specifically approved by Engineer.
- D. Protective Device Rating and Setting Chart: Summarize in tabular format required characteristics for each protective device based on analysis; include:
1. Device identification.
 2. Relay CT ratios, tap, time dial, and instantaneous pickup.
 3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
 4. Fuse rating and type.
 5. Ground fault pickup and time delay.
 6. Input level and expected response time at two test points that are compatible with commonly available test equipment and ratings of protective device.
 7. Highlight devices that as furnished by Contractor will not achieve required protection.
- E. Specified equipment has been designed and selected to achieve specified performance; ensure that equipment actually installed provides that performance.
- F. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings in accordance with results of system studies.
- 2.3 SHORT CIRCUIT STUDY
- A. Calculate fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
1. Show fault currents available at key points in system down to fault current of 1,000 A at 480 V and 208 V.
 2. Include motor contributions in determining momentary and interrupting ratings of protective devices.
 3. Primary Fault Level Assumptions: Obtain data from utility company.
- 2.4 ARC FLASH RISK ASSESSMENT
- A. Calculate arc flash incident energy (AFIE) levels and flash protection boundary distances to determine required level of personal protective equipment (PPE) at each bus and piece of equipment during normal conditions, emergency power conditions, and other operations that could result in maximum arc flash incident energy levels.
1. Show flash protection boundary distance.

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ELECTRICAL DISTRIBUTION SYSTEM STUDIES

2. Include incident energy levels.

2.5 **ARC FLASH LABELS**

- A. Provide label compliant with NFPA 70E guidelines indicating personal protective equipment (PPE) recommended for servicing of electrical equipment while energized, as well as calculated incident energy levels and arc flash protective boundary distance.

PART 3 - EXECUTION

3.1 **FIELD QUALITY CONTROL**

- A. Provide services of qualified field engineer and necessary tools and equipment to test, calibrate, and adjust installed protective devices to conform to requirements determined by coordination analysis.
- B. Adjust installed protective devices having adjustable settings to conform to requirements determined by coordination analysis.
- C. Submit report showing final adjusted settings of protective devices.

3.2 **ELECTRICAL POWER SYSTEM STUDIES**

- A. Short Circuit Analysis Study:
 1. Provide complete short circuit study, equipment interrupting and withstand evaluation. Study to include complete electrical distribution system, including contributions from normal source of power without alternative sources of power. Include complete low voltage distribution systems as specified in this Section.
 2. Study Basis: thoroughly cover normal and alternative operation modes that can produce maximum fault conditions, including simultaneous motor contributions.
 3. Perform study in accordance with applicable ANSI/IEEE Standards.
 4. Study Input Data: Utility company short circuit single and three phase contribution, and X/R ratio; resistance and reactance components of each feeder, busway and branch impedance; motor and generator contributions; applicable circuit parameters and contribute to short circuit duty.
 5. Calculate short circuit momentary duties and interrupting duties on basis of maximum available fault current at each switchgear bus, switchboard, motor control center, panelboard, transfer switch, busway plug, dry-type transformer primary and secondary and other significant locations throughout system affected by available fault current (including large equipment, disconnects, control panels, uninterruptible power supplies, etc.).
 6. Perform equipment evaluation study to determine adequacy of overcurrent protection devices by tabulating and comparing short circuit ratings of these devices with available fault current. Notify Owner in writing where problem areas or inadequacies appear in electrical equipment.
 7. Study Report: In bound final report, include sheets listing tabulated information from study, including feeder impedances, motor, utility and generator impedances and fault contributions, and resulting short circuit current including asymmetrical, symmetrical, three, five and eight cycle fault current levels, and line-to-neutral and three-phase-bolted-fault current levels at each calculated point in electrical distribution system.
- B. Arc Flash Risk Assessment:
 1. Perform arc flash risk assessment with aid of computer software intended for this purpose.
 2. Perform arc flash risk assessment in conjunction with short-circuit analysis and time-current coordination analysis.
 3. Submit results of assessment in tabular form, and include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.

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ELECTRICAL DISTRIBUTION SYSTEM STUDIES

4. Perform analysis under worst-case arc flash conditions, and final report describes, when applicable, how these conditions differ from worst-case bolted fault conditions.
5. Arc flash risk assessment includes recommendations for reducing AFIE levels and enhancing worker safety.
6. Proposed vendor demonstrates experience with arc flash risk assessment by submitting names of at least ten actual arc flash risk assessments it has performed in past year.
7. Proposed vendor demonstrates capabilities in providing equipment, services, and training to reduce arc flash exposure and train workers in accordance with NFPA 70E and other applicable standards.
8. Proposed vendor demonstrates experience in providing equipment labels in compliance with NEC and ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes.

END OF SECTION

SECTION 26 09 23
OCCUPANCY AND VACANCY SENSORS

SECTION 26 09 23 - OCCUPANCY AND VACANCY SENSORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Occupancy/Vacancy Sensors (Ceiling Mounted)
 - 2. Combined Occupancy Sensor/Wall Switches ("Sensor/Switches")

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Provide wiring diagrams indicating low voltage and line voltage wiring requirements.
 - 2. Provide, on reproducible architectural floor plan, a layout of sensors indicating their sensing distribution.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Use manufacturer's published testing and adjusting procedures to adjust sensors time delay, daylight sensitivity, and passive infrared sensitivity to satisfaction of the Owner.
 - 2. Prepare and complete report of test procedures and results. Submit these test procedures and results to Owner and Architect.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Occupancy/Vacancy Sensors (Ceiling Mounted):
 - 1. Ultrasonic Occupancy/Vacancy Sensors:
 - a. WattStopper
 - b. Leviton
 - c. Hubbell
 - d. Cooper/Greengate
 - e. Acuity Controls
 - f. Lutron
 - g. Or approved equivalent.

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2. Dual Technology Occupancy/Vacancy Sensors:
 - a. WattStopper
 - b. Leviton
 - c. Hubbell
 - d. Cooper/Greengate
 - e. Acuity Controls
 - f. Lutron
 - g. Or approved equivalent.
- B. Combined Occupancy Sensor/Wall Switches ("Sensor/Switches"):
 1. Lutron
 2. Acuity Controls
 3. WattStopper
 4. Leviton
 5. Hubbell
 6. Cooper/Greengate
 7. Or approved equivalent.
- C. Basis of Design: Occupancy/Vacancy sensors are designed based on WattStopper product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including complete sensor coverage of the area controlled and switching of luminaires in the area controlled. Provide additional sensors and power switch packs as needed to provide the same level of functionality as shown on Drawings or required in Specifications. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

2.2 GENERAL

- A. Occupancy sensor designation indicates sensors automatically turn lights ON when the sensor detects the presence of a person and will automatically turn lights OFF when no presence is detected for a specified amount of time (automatic-on and automatic-off).
- B. Vacancy sensor designation requires someone to manually turn the lights ON. The sensor will then automatically turn the lights OFF when no presence is detected for a specified amount of time (manual-on and automatic-off).
- C. Provide occupancy sensors to sense presence of human activity within desired space and enable or disable on/off manual lighting control function provided by local switches.
- D. Upon detection of human activity by detector, sensor initiates time delay to maintain lights on for present period of time. Field adjustable time delay setting from 30 seconds to 15 minutes.
- E. Factory set sensors for maximum sensitivity.
- F. LED lamp built into sensor indicates when occupant is detected.
- G. Provide zero cross relay control with sensors and sensor/switched; relay contacts close and open with AC voltage signal is at zero.
- H. Where line voltage sensors and sensor/switches are used, provide to match voltage of controlled circuit.
- I. Line Voltage Sensors, Control Units, and Relays: UL listed.

2.3 OCCUPANCY/VACANCY SENSORS (CEILING MOUNTED)

- A. Ultrasonic Occupancy/Vacancy Sensors:
 1. Sensor Function: Detects human presence in controlled floor area by detecting Doppler shifts in 40kHz ultrasound created by sensor.
 2. Sensors are precision crystal controlled and do not interfere with each other when two or more are placed in same area. Sensor includes advanced digital signal processing to reduce false on signals without decreasing sensitivity, as well as immunity to RFI/EMI sources.
 3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.

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OCCUPANCY AND VACANCY SENSORS

4. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel to allow coverage of large areas.
 5. Provide adjustments and mounting hardware under removable cover to prevent tampering.
 6. Finish: Match building standard.
 7. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Maximum protrusion of 1.1-inches and blend in aesthetically with ceiling.
 - c. 360 degree sensor range; Coverage: 2,000-square feet, unless otherwise noted on Drawings.
 - d. Provide internal form C dry contacts for HVAC control.
 8. Ceiling Mounted Sensor - Hallway Sensor Coverage:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Maximum protrusion of 1.5-inches and blend in aesthetically with ceiling.
 - c. Coverage: 90 linear feet.
 - d. Provide internal form C dry contacts for HVAC control.
- B. Dual Technology Sensors:
1. Sensor Function: Combined capability of passive infrared with ultrasonic or microphonic technology as described above. Upon a person entering a space, motion must be sensed by both technologies before lighting will be turned on. After this has occurred, detection by either technology will hold lighting on. Sensors retrigger time delay where only one motion is necessary to turn on lights within 5 seconds after turning off.
 2. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.
 3. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel to allow coverage of large areas.
 4. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. 360 degree sensor range; Coverage: 1,000-square feet for half-step motion, unless otherwise noted on Drawings.
 - c. Provide internal form C dry contacts for HVAC control.
- 2.4 COMBINED OCCUPANCY SENSOR/WALL SWITCHES ("SENSOR/SWITCHES")
- A. Completely self-contained sensor system that fits into standard single gang box. Internal transformer power supply, latching dry contact relay switching mechanism compatible with LED drivers, compact fluorescent, and inductive loads. Triac and other harmonic generating devices are not allowed.
 - B. Passive infrared sensor technology includes advanced signal processing to reduce false triggers without increasing sensitivity. LED indicator blinks when occupant sensed.
 - C. Rated to switch loads: 1000 watts at 120-volt; 1200 watts at 277 volt. Zero-crossing technology switches lighting off when AC voltage is at zero, minimizes contact wear.
 - D. Adjustable high-end and low-end trim setting.
 - E. Provide adjustable daylight feature that holds lighting "off" when desired footcandle level is present.
 - F. Provide integral off override switch with no leakage current to load or ground.
 - G. Vandal-resistant lens.
 - H. Includes neutral wire to meet NEC.
 - I. Finish: Match building standard.
 - J. Alerts for impending shut-off: light flash, audible, both or none.
 - K. Standard Sensor/Switch:

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OCCUPANCY AND VACANCY SENSORS

1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off). Factory set to manual on/auto off.
2. 180 degree sensor range; Coverage: 180-square feet for desktop activity.
- L. Dual Relay Sensor/Switch:
 1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 2. Dual auto-off buttons on face of switch allow end-user to turn off two switch legs in room space. Built-in light adjustable level sensor only turns off second of two relays when desired footcandle level is present. Otherwise similar to specifications above for single-zone sensor/switch.
 3. Defaults to Manual-ON to 50 percent operation for maximum energy savings.
 4. 180 degree sensor range; Coverage: 150-square feet for desktop activity.
 5. Finish: Match building standard.
- M. Sensor/Slide Dimmer:
 1. Line voltage dimmer allows for adjustment of lighting levels from 100 percent to 10 percent; compatible with two-wire line voltage 100 percent to 10 percent electronic dimming ballasts. Separate manual button for override 'off' control.
 2. 180 degree sensor range; Coverage: 300-square feet for desktop activity.
- N. Passive Infrared Wall Switch Vacancy-Only Sensors:
 1. Operates only as a vacancy sensor (manual-on and automatic-off).
 2. Adjustable sensitivity (high, low presets).
- O. Dual Technology Wall Switch Vacancy-Only Sensors:
 1. Operates only as a vacancy sensor (manual-on and automatic-off).
 2. Adjustable sensitivity (high, medium, low, and off presets) individually for passive infrared and ultrasonic sensing.
- P. Passive Infrared Wall Dimmer Vacancy-Only Sensors:
 1. Operates only as a vacancy sensor (manual-on and automatic-off).
- Q. Passive Infrared 0-10 V Wall Dimmer Vacancy-Only Sensors:
 1. Operates only as a vacancy sensor (manual-on and automatic-off).
- R. Dual Technology 0-10V Wall Dimmer Vacancy Sensors:
 1. Operates only as a vacancy sensor (manual-on and automatic-off).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install occupancy/vacancy sensors as directed by manufacturer's instructions. Complete connections to control circuits, occupancy sensors, power supply pack and low voltage wiring.
- B. Provide power packs for sensor to control number of circuits and/or switch legs within its area of coverage.
- C. Field adjust each sensor to maximize its coverage of room space.
- D. Relocate sensors with ultrasonic technology to avoid being closer to HVAC diffusers and power packs than recommended by manufacturer.
- E. Field set time delay for each device as noted below:
 1. Offices, Workrooms: 30 minutes.
 2. Restrooms: 15 minutes.
 3. Storage Rooms, Janitor's Closets, Unisex Restrooms: 5 minutes.
 4. All Other Spaces: 15 minutes.
 5. Time Switches: 2-hours.
- F. Coordinate HVAC control requirements with controls contractor prior to installation.
- G. Lighting System Testing and Commissioning:
 1. Test lighting controls to ensure that control devices, components, equipment, and systems are calibrated, adjusted, and operate in accordance with Drawings and

SECTION 26 09 23
OCCUPANCY AND VACANCY SENSORS

Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to engineer and insert approved copy into project closeout documents.

2. Testing includes:
 - a. Daylight Automatic Controls.
 - b. Occupant Sensing Automatic Controls.
 - c. Automatic Time and Override Controls for Interior Lighting.
 - d. Automatic Time and Photo Controls for Exterior Lighting.

END OF SECTION

SECTION 26 09 24
DAYLIGHTING CONTROLS

SECTION 26 09 24 - DAYLIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Local Continuous Dimming Photosensor

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 01, General Requirements and Section 26 00 00, Electrical Basic Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Wiring diagrams indicating low voltage and line voltage wiring requirements.
 - 2. A layout of sensors indicating their sensing distribution on reproducible architectural floor plan.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Daylighting controls that carry a factory warranty for a minimum 5-year duration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Local Continuous Dimming Photosensor:
 - 1. WattStopper
 - 2. Greengate
 - 3. Acuity Controls
 - 4. Leviton Lighting Controls
 - 5. Hubbell Control Solutions
 - 6. Or approved equivalent.
 - 7. Basis of Design: Daylighting sensor layout on Drawings are designed based on WattStopper product line. Approved manufacturers listed below are allowed on condition of meeting specified conditions including complete sensor coverage of area controlled and switching of luminaires in area controlled. Provide additional sensors and power switch packs as needed to provide same level of functionality as shown on Drawings. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

**SECTION 26 09 24
DAYLIGHTING CONTROLS**

2.2 LOCAL CONTINUOUS DIMMING PHOTOSENSOR

- A. Provide low voltage, indoor photocell to interface with electronic dimming ballasts using low voltage (0 to 10VDC) control signal.
- B. Spectral filtering system to measure relative levels of daylighting and indoor lighting within control space. Measures light as human eye perceives; linear photocell response with greater than 1 percent accuracy.
- C. Ceiling-mounted 2.4-inch diameter, 0.875-inch depth white housing.
- D. 10VDC input voltage, 0.2 to 10VDC output voltage. 20 to 60 footcandle adjustable range with plus or minus 3 percent accuracy. One photocell controls up to 50 drivers. 5 year warranty. White finish.
- E. Automatic Off Control.
- F. Provide with separate handheld remote controller to field program target lighting levels for daytime and nighttime (i.e. when plenty of daylighting is available and when no daylighting is available).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install photocells as directed by manufacturer's instructions. Complete connections to control circuits, photocells, control modules, power supply pack and low voltage wiring.
- B. Photocell placement and wiring:
 - 1. Drawings are schematic, and show photocell quantities together with the daylighting zones that they control.
 - 2. Reference manufacturer installation instructions for the recommended location and orientation of photocell with respect to exterior glazing and both interior and exterior lighting.
 - 3. Reposition sensor at no additional cost to Owner to avoid conflict between sensor and object obscuring its view, and between sensor and both interior and exterior lighting that causes daylighting controls to repeatedly increase and decrease in brightness (i.e. "cycling").
 - 4. Field wire photocell for correct footcandle range.

3.2 LIGHTING SYSTEM CALIBRATION, DEMONSTRATION, TRAINING, TESTING, AND COMMISSIONING

- A. Prior to adjusting and calibrating daylighting control system and local photocell field adjustable settings, contact local manufacturer representative and arrange for representative to visit site to educate both field installer and Owner's Authorized Representative on the operation of the controls.
- B. Use manufacturer's published testing and adjusting procedures to adjust sensors and daylight sensitivity to the satisfaction of Owner.
- C. Daylight Dimming Zone Calibration:
 - 1. After all furniture is installed, all daylighting zones are to be field calibrated using a digital photometer. Adjust photocell and control system parameters to maintain an even light level at the work plane.
 - 2. Single and dual daylighting zones are to be adjusted to maintain an even light level at the work plane throughout connected zones and adjoining areas.
- D. Daylight Dimming Zone Lighting Level Setpoints:

Area	Setpoint (Average Footcandles)
Open Offices	40 FC
Private Offices	40 FC
Conference Rooms	30 FC
Corridors	25 FC

**SECTION 26 09 24
DAYLIGHTING CONTROLS**

Lobby	10 FC
Classrooms	30 FC
Fitness/Exercise Area	30 FC
Kitchen	50 FC
General Warehouse/Storage	20 FC

- E. Prepare and complete report of test procedures and results including the final daylighting level setpoints as set while using a digital photometer. Submit these test procedures and results to Architect and Engineer.
- F. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to Architect and Engineer and insert approved copy into project closeout documents.
- G. Testing Includes:
 - 1. Daylight Automatic Controls
 - 2. Occupant Sensing Automatic Controls
 - 3. Automatic Time and Override Controls for Interior Lighting
 - 4. Automatic Time and Photo Controls for Exterior Lighting
- H. Training: Provide minimum 2-hour training session to Owner's Authorized Representatives at a time approved by Owner after Owner has received approved operation and maintenance manuals. Training to include discussion of operation, adjustment, and replacement of sensors, photocells, and control.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Two-Winding Transformers
 - 2. Buck-and-Boost Transformers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. UL 1561: Dry-Type General Purpose and Power Transformers.
 - 2. NEMA ST 20, Dry-Type Transformer for General Applications.
 - 3. IEEE C57.110, Recommended Practice for Establishing Transformer Capability when Supplying Nonsinusoidal Load Currents.
 - 4. CFR, Title 10, Chapter II, Sub-chapter D, Part 431, Subpart K, Energy Conservation Standards. Department of Energy (DOE) Efficiency Standards, effective Jan. 1, 2016.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Product Data: Provide data showing dimensions, weights, primary/secondary voltage, phase, connection types, frequency, rating, impedance, temperature rise, efficiency, coil material, enclosure type, K factor, and sound levels.
 - 2. Test Reports: Indicate results of factory testing as defined within this Section.
 - 3. Operation Data: Include instructions for normal operation.
 - 4. Maintenance Data: Include instructions for routine maintenance and testing requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Provide factory production testing per applicable standards.
 - a. NEMA ST-20.
 - b. 10 CFR Part 431 Part K Appendix A.
 - 2. Test each model design and submit the following reports on request.
 - a. Applied potential test
 - b. Induced voltage test
 - c. Impedance voltage and load loss test
 - d. Voltage ratio test
 - e. No load and excitation current test
 - f. Short circuit test, BIL (Basic Impulse Insulation Level) test
 - g. Partial discharge test
 - h. Sound level test

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

- i. Temperature rise test

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Schneider Electric/Square D
- B. Eaton
- C. ABB/General Electric
- D. Siemens
- E. Hammond Power Solutions
- F. Or approved equivalent.
- G. Basis of Design: Schneider Electric/Square D. Manufacturers listed are allowed on condition of meeting specified conditions including available space for equipment and Code required working clearances. Remove and replace equipment installed that does not meet these conditions at no cost to Owner.

2.2 TWO-WINDING TRANSFORMERS

- A. Description: Factory assembled, air cooled dry type transformer. Efficiency compliant with Federal Code 10 CFR Part 431 and DOE 2016 efficiency requirements. NEMA TP-1 efficiency levels are not acceptable.
- B. Windings: Aluminum.
- C. Insulation system and average winding temperature rise for rated kVA as follows:
 - 1. 1-15 kVA: Class 220 with 115 degrees C rise.
 - 2. 16-500 kVA: Class 220 with 115 degrees C rise.
- D. Maximum Winding Temperature: Do not exceed 30 degrees C rise above 40 degrees C ambient at warmest point at full load.
- E. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: NEMA ST 20.
- F. Conductor Termination Lugs: Compression.
- G. Sound Levels: NEMA ST 20.
- H. Basic Impulse Level: 10 kV.
- I. Impedance: 3 to 5 percent, unless otherwise noted on Drawings. Minimum reactance 2 percent.
- J. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- K. Mounting:
 - 1. 1-15 kVA: Suitable for wall mounting.
 - 2. 16-75 kVA: Suitable for floor mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- L. Coil Conductors: Continuous windings with terminations brazed or welded.
- M. Transformer Enclosure: NEMA ST 20.
 - 1. Interior: Type 1.
 - 2. Exterior: Type 3R.
 - 3. Ventilated.
 - 4. Provide lifting eyes or brackets.
- N. Isolate core and coil from enclosure using vibration-absorbing mounting pads.
- O. Nameplate: Reference Section 26 05 53, Identification for Electrical Systems.

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

2.3 BUCK-AND-BOOST TRANSFORMERS

- A. Description: NEMA ST 1, factory-assembled, dry type two winding buck and boost transformers.
- B. Insulation system and average winding temperature rise for rated kVA as follows:
 - 1. 0.25-2 kVA: Class 185 with 80 degrees C rise.
 - 2. 3-7.5 kVA: Class 220 with 115 degrees C rise.
- C. Windings: Copper.
- D. Mounting: Wall.
- E. Coil Conductors: Continuous windings.
- F. Lugs: Suitable for terminating conductors sized for full load ampacity of transformer unit when operating in buck-and-boost configuration shown.
- G. Enclosure: NEMA ST 1, Type 1.
- H. Isolate core and coil from enclosure using vibration-absorbing mounting pads.
- I. Nameplate: Include transformer connection data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set transformers plumb and level.
- B. Use flexible conduit, 2-foot minimum length with slack, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer. Mount to allow a minimum of 6-feet, 6-inches headroom below unit.
- D. Mount trapeze-mounted transformers as indicated.
- E. Clearance: Minimum 6-inches clear on sides and back. Front clearance per NEC 110.26. Maintain minimum clearance from combustible materials per NEC. Comply with manufacturers recommendations.
- F. Exterior Installations: Weather resistant enclosure.
 - 1. Provide 8-inches diameter by 24-inches (above and below grade) concrete filled steel bollards where subject to vehicular traffic.
 - 2. Where grouped with switchgear refinish as required so that transformers and switchgear match in color.
- G. Unacceptable Humming and Noise Levels: Revise installation as required to achieve a noise level less than or equal to those defined in NEMA ST-20 for associated transformer size or replace with a new unit with an acceptable sound level.
- H. Provide Concrete Housekeeping Pad:
 - 1. Interior Pads: Extend pad 4-inches beyond transformer width and depth dimensions. Top of pad minimum 3-inches above finish floor. Install pad plumb and level.
 - 2. Exterior Pads: Provide concrete pads of 2,500 to 3,000 PSI concrete reinforced with 8 gauge wire fabric or No. 6 reinforcing bars on 12-inch centers. Provide 10-inch thick base of gravel below pad for support. Pad extends 6-inches on all sides from exterior most prominent dimension. Provide 3/4-inch by 10-foot ground rod at each corner bonded to No. 2 AWG bare copper grounding conductor, bonded to transformer and concrete reinforcement.
 - 3. Housekeeping pads provided under provisions of Division 03, Concrete.
- I. Provide equipment nameplates per Section 26 05 53, Identification for Electrical Systems.
- J. Provide arc flash labels per Section 26 05 73, Electrical Distribution System Studies.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting.

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LOW-VOLTAGE TRANSFORMERS

- B. Perform inspections and tests listed in accordance with manufacturers' requirements. In addition, include the following:
 - 1. Perform turns ratio tests at tap positions.
 - 2. Verification that as-left tap connections are as specified.
 - 3. Perform excitation-current tests on each phase.
 - 4. Measure resistance of each winding at each tap connection.
 - 5. Overpotential test on high- and low-voltage windings-to-ground.
 - C. Check for damage and tight connections prior to energizing transformers.
- 3.3 ADJUSTING
- A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Panelboards

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 73, Electrical Distribution System Studies.
 - 2. Section 26 28 00, Overcurrent Protective Devices.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. UL 67, Standards for Panelboards.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 2. Shop Drawings: For each panelboard and related equipment.
 - a. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - 1) Enclosure types and details for types other than NEMA 250, Type 1.
 - 2) Bus configuration, current, and voltage ratings.
 - 3) Short-circuit current rating of panelboards and overcurrent protective devices.
 - 4) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - b. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Operation and Maintenance Manuals:
 - a. After completion of work and start-up of the equipment at the project site, deliver to the Owner's Authorized Representative operation instructions, maintenance manuals and drawings presenting full details for care and maintenance of each type of equipment provided under this Contract. Number of copies in accordance with Division 01.
 - b. Each copy to contain the operating and maintenance information and parts lists for equipment provided under this Contract. When necessary, provide supplemental drawings to show system operation and servicing maintenance points. For electrical components, provide wiring and connection diagrams. Include instructions required to accomplish

**SECTION 26 24 16
PANELBOARDS**

- specified operation and functions. Data to be neat, clean and legible.
- c. Panelboard drawings and wiring diagrams to be included and up to date at the completion of start-up and system acceptance by the Owner. Drawings and wiring diagrams to include any field modifications or changes to reflect actual as-installed conditions.
 - d. In general, the manual to include, but not necessarily be limited to, the following:
 - 1) Panelboard Elevation and One Line.
 - 2) AC and DC Schematic and Physical Component Layout Drawings.
 - 3) Remote Interface Drawing.
 - 4) Bill of Material.
 - 5) Description of Operation.
- C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, accessories, and components will withstand seismic forces defined in Section 26 00 00, Electrical Basic Requirements.
- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 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 on their installation requirements.
 - 4. Submit emergency system performance test results per NFPA 110-7.13.

1.5 **QUALITY ASSURANCE**

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 **WARRANTY**

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

- A. Panelboards:
 - 1. Eaton
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Basis of Design: Schneider Electric/Square D
 - 5. Or approved equivalent.
- B. Manufacturers listed above are allowed on condition of meeting specified conditions including available space for equipment, Code required working clearances, selective coordination per Section 26 05 73, Electrical Distribution System Studies, and amps interrupting capacity (AIC) per short circuit study in Section 260573, Electrical Distribution System Studies. Prior to submitting bid, manufacturer to provide documentation to Engineer verifying specific conditions, including those mentioned above, can be met. Remove and replace electrical equipment installed, at no cost to the Owner, that does not meet these conditions.

SECTION 26 24 16
PANELBOARDS

2.2 PANELBOARDS

- A. Description: Panelboards 400 amps or less. NEMA PB1, Type 1 or as indicated on drawings, circuit breaker type. Maximum enclosure depth: 6-inches for surface mounted, 5-3/4-inches for flush mounted.
- B. Maximum Width: 20-inches.
- C. Integrated Equipment Rating: Provide fully rated integrated equipment rating greater than the available fault current. Series rated panelboards are not acceptable. Reference drawings for available fault current. If drawings do not have available fault current shown, then coordinate with serving electrical utility. Final rating based on the protective device study completed under the provisions of Division 26, Electrical Distribution System Studies.
- D. Panelboard Bus Non-Reduced: Copper, ratings as indicated on drawings. Bus bar with suitable electroplating (tin) for corrosion control at connection. Provide copper ground bus in each panelboard.
- E. Lugs: Mechanical type for both aluminum and copper conductors. All device terminals/lugs shall be rated for a minimum of 75 degrees C to facilitate the use of 75 degrees C conductor ampacity rating.
- F. Provide double lugs and/or feed-through lugs for feed through feeders.
- G. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type/secured connection with frame, with common trip handle for poles; UL listed. Pre-drill bus for bolt-on breakers.
 - 1. Type SWD for lighting circuits.
 - 2. Type HACR for air conditioning equipment circuits.
 - 3. Class A ground fault interrupter circuit breakers where scheduled.
 - 4. Class B ground fault equipment protection circuit breakers for heat trace and other circuits as required by Code. Provide shunt trip circuit breakers where scheduled; provide wiring to remote trip switch/contacts as indicated on Drawings.
 - 5. Do not use tandem circuit breakers.
- H. Accessories: Provide where indicated: shunt trip and Class A ground fault circuit interrupter (GFCI).
- I. Cabinet Front: Provide flush or surface mounting as shown on the schedules, drawings, or otherwise noted. Cabinet front with concealed hinged front cover construction, metal directory frame with heavy clear plastic protector, flush lift latch and lock, two keys per panel all keyed alike.
- J. Provide boxes with removable blank end walls and interior mounting studs. Provide interior support bracket for ease of interior installation.
- K. Furnish surface mounted cabinet boxes without knockouts.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install panelboards in accordance with NEMA PB 1.1, NECA 1 and manufacturer's installation instructions.
- B. Install panelboards level and plumb. Install recessed panelboards flush with wall finishes.
- C. Height: 6-feet 6-inches to top of panelboard; install panelboards taller than 6-feet 6-inches with bottom no more than 4-inches above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Include all "spaces" and "spares." Revise directory to reflect circuiting changes and as-installed conditions. Use final Owner designated room names and numbers, and not designations shown on drawings.

SECTION 26 24 16
PANELBOARDS

- F. Provide engraved plastic nameplates per Section 26 05 53, Identification for Electrical Systems.
- G. Provide arc flash labels per Section 26 05 73, Electrical Distribution System Studies.
- H. Provide concrete housekeeping pad for floor-mounted distribution panelboards. Extend 6-inches beyond distribution panel width and depth dimensions. Minimum 3-inches above finished floor. Install plumb and level.
- I. Provide two 1-inch spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
- J. Provide permanent identification number in or on panelboard dead-front adjacent to each breaker pole position. Horizontal centerline of numbers to correspond with centerline of circuit breaker pole position.
- K. Ground and bond panelboard enclosure per NEC.
- L. Paint:
 - 1. Standard factory finish unless noted otherwise.
 - 2. Panelboards located in finished interior areas in view of building occupants; paint to match adjacent wall surface. Color and paint preparation as specified by Architect. Covers to be painted off wall, then installed over dried, painted wall surface.
- M. Provide handle guards on each circuit supplying obviously constant loads such as fire alarm, security, lighting controls, refrigerators and freezers, fire protection, etc.
- N. Provide interior wiring diagram, neutral wiring diagram, UL label, and short circuit rating on interior or in booklet format inserted in sleeve inside panel cover.
- O. Verify available recessing depth and coordinate wall framing with other divisions.
- P. Maintain fire rating of wall where panels are installed flush in fire rated walls.
- Q. Perform inspections and tests in accordance with manufacturer's requirements.
- R. Thoroughly clean exterior and interior of each panelboard in accordance with manufacturer's installation instructions.
- S. Vacuum construction dust, dirt, and debris out of each panelboard.
- T. Where enclosure finish is damaged, touch up finish with matching paint in accordance with manufacturer's specifications and installation instructions.

3.2 PANELBOARDS INSTALLATION

- A. Breakers being added to existing panelboards: Coordinate breaker type and short circuit rating with existing panelboard. Breakers to match existing in manufacturer's type and AIC rating. Provide new typed circuit directory.
- B. Provide handle tie to branch circuit breakers of multiwire branch circuits for simultaneous disconnection of circuits. Handle tie will be identified for use with circuit breakers provided. Reconfigure assigned circuits as necessary so that circuit breakers associate with multiwire branch circuits are physically adjacent, record changes in panelboard schedules and circuiting plans for record drawings.
- C. Shunt Trip Circuit Breakers: Provide wiring to remote trip switch/contacts as indicated on Drawings.
- D. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

**SECTION 26 27 26
WIRING DEVICES**

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
 - 1. Wall Switches
 - 2. Receptacles
 - 3. Finish Plates
 - 4. Wall Dimmers
 - 5. Surface Covers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Wall Switches
 - 2. Receptacles
 - 3. Wall Plates
 - 4. Dimmers
 - 5. In-Use Cover

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wall Switches:
 - 1. Toggle Type:
 - a. Cooper
 - b. Hubbell
 - c. Leviton
 - d. Legrand
 - e. Or approved equivalent.
 - 2. Timer Switches:
 - a. WattStopper
 - b. Or approved equivalent.
- B. Receptacles:

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WIRING DEVICES**

1. Commercial Grade:
 - a. 20 Amp:
 - 1) Cooper
 - 2) Hubbell
 - 3) Bryant
 - 4) Leviton
 - 5) Legrand P&S
 - 6) Or approved equivalent.
 2. Ground Fault Circuit Interrupter (GFCI), Tamper-Resistant Receptacle - 20 Amp:
 - a. Cooper
 - b. Hubbell
 - c. Legrand P&S
 - d. Or approved equivalent.
- C. Finish Plates:
1. Bryant
 2. Cooper
 3. Hubbell
 4. Leviton
 5. Legrand P&S
 6. Or approved equivalent.
- D. Wall Dimmers:
1. Lutron Maestro Series
 2. Or approved equivalent.
- E. Surface Covers:
1. While-in-Use Weatherproof Outlet Cover:
 - a. UV Stabilized Polycarbonate Cover:
 - 1) Legrand P&S
 - 2) Intermatic
 - 3) Hubbell
 - 4) Cooper
 - 5) Or approved equivalent.
- F. Provide lighting switches and receptacles of common manufacturer and appearance.
- 2.2 WALL SWITCHES
- A. Characteristics: Toggle type, quiet acting, 20 amp, 120/277 volt, UL listed for motor loads up to 80 percent of rated amperage, extra heavy duty.
 - B. Timer Switches: Digital time switch to automatically turn light off after set time. Adjustable time setting from five minutes to 12 hours. LCD to show time remaining. 20-amp/120 to 277 volt.
 - C. Finish: Match Building Standard.
- 2.3 RECEPTACLES
- A. Duplex Receptacles Characteristics: Straight parallel blade, 125 volt, 2 pole, 3 wire grounding.
 1. Commercial Grade: Riveted. Back and side wired. Brass ground contact on steel strap. Nylon face and nylon base. 20 amp.
 - B. Ground Fault Circuit Interrupter (GFCI) Receptacle: Feed through type, back-and-side wired, tamper-resistant, weather resistant self-testing, 20 amp, 125 VAC.
 - C. Special Purpose Receptacles: Reference equipment manufacturer's requirements and available voltage and current NEMA Standard Specification.
 - D. Finish:
 1. Same exposed finish as switches.
 2. Receptacles connected to emergency circuits life safety and critical to have red finish.

SECTION 26 27 26
WIRING DEVICES

- 2.4 FINISH PLATES
- A. Finish Plates: Match building standard.
 - B. Provide telephone/signal device plates; activated outlets to have coverplates to match modular jack.
- 2.5 WALL DIMMERS
- A. Provide wall dimmers compatible with type of load controlled (i.e. line voltage, 2-wire, 3-wire). Finish to match wall switches. Size dimmers to accept connected load. Do not cut fins. Where dimmers are ganged together, provide a single multi gang coverplate.
- 2.6 SURFACE COVERS
- A. Material: Galvanized steel, drawn, 1/2-inch raised industrial type with openings appropriate for devices installed on surface receptacles.
 - B. Cast Box and Extension Adaptors: Aluminum with gasket, blanks single-gang or 2-gang.
 - C. While-in-Use Weatherproof Cover: NEMA 3R when closed over energized plug. Vertical mount for duplex receptacle. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.
 - 1. UV stabilized polycarbonate cover with closed cell neoprene foam gasket. Capable of being locked closed to prevent tampering or unauthorized use.

PART 3 - EXECUTION

- 3.1 GENERAL INSTALLATION REQUIREMENTS
- A. See Architectural elevations for location and mounting height of wiring devices. Review Architectural elevations prior to rough-in and contact Architect immediately if conflicts are found between Architectural and Electrical Drawings. Do not rough-in devices until conflicts are resolved.
 - B. Install wiring devices and finish plates plumb with building lines, equipment cabinets and adjacent devices. Devices not plumb will be fixed at no additional cost to Owner.
 - C. Orientation:
 - 1. Install wiring devices with long dimension oriented vertically at centerline height shown on drawings or as specified.
 - 2. Vertical Alignment: When more than one device is shown on Drawings in close proximity to each other, but at different elevations, align devices on a common vertical center line for best appearance. Verify with Architect.
 - 3. Horizontal Alignment: When more than one device is shown on drawings in close proximity to each other with same elevation, align devices on a common horizontal center line for best appearance. Verify with Architect.
 - D. Provide labeling per Section 26 05 53, Identification for Electrical Systems.
 - E. Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.
- 3.2 WALL SWITCHES INSTALLATION
- A. At time of substantial completion, replace those items which have been damaged.
- 3.3 RECEPTACLES INSTALLATION
- A. Upon installation, adhere to proper and cautious use of convenience receptacles. At time of substantial completion, replace those items which have been damaged, including those burned and scored by faulty receptacles or cord caps.
 - B. In the following outlet locations, regardless of whether shown as GFCI on Drawings, either provide a GFCI duplex receptacle, or use a GFCI breaker where code would require a GFCI outlet to have a remote test switch:

**SECTION 26 27 26
WIRING DEVICES**

1. Bathrooms.
 2. Where receptacles are installed within 6-feet, 0-inches from edge of sinks.
 3. Kitchens above counters.
 4. On rooftops.
 5. Outdoors.
 6. Where serving vending machines.
 7. Where serving electric drinking fountains.
- C. GFCI Receptacles: One GFCI receptacle may not be used to provide GFCI protection to downstream duplex receptacles on the same branch circuit.
- 3.4 FINISH PLATES INSTALLATION
- A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.
- 3.5 WALL DIMMERS INSTALLATION
- A. Install per manufacturer's recommendations and wiring diagrams.
- 3.6 SURFACE COVERS INSTALLATION
- A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

END OF SECTION

SECTION 26 28 00
OVERCURRENT PROTECTIVE DEVICES

SECTION 26 28 00 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Fuses
 - 2. Molded Case Circuit Breakers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Product data and instantaneous let-through current curves and average melting time current curves for fuses supplied to project.
 - 2. Product data and time/current trip curves for circuit breakers supplied to project.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fuses:
 - 1. Bussmann
 - 2. Ferraz-Shawmut
 - 3. Littelfuse
 - 4. McGraw-Edison
 - 5. Or approved equivalent.
- B. Molded Case Circuit Breakers:
 - 1. Basis of Design:
 - a. Schneider Electric/Square D
 - 2. Cutler-Hammer
 - 3. ABB/General Electric
 - 4. Or approved equivalent.

2.2 FUSES

- A. Characteristics:

SECTION 26 28 00
OVERCURRENT PROTECTIVE DEVICES

1. Dual element, time delay, current limiting, nonrenewable type, rejection feature. Blown-fuse indicator window.
2. Combination Loads: UL Class RK1, 1/10 to 600 amp. UL Class L, above 600 amps.
3. Fuse pullers for complete range of fuses.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. 1-, 2- or 3-pole bolt-on, single handle common trip, 600VAC or 250VAC as indicated on Drawings.
- B. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- C. Calibrate for operation in 40 degrees C ambient temperature.
- D. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination:
 1. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
 2. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to overcurrent protective devices as necessary to coordinate with the nameplate rating.
- B. Install all items in accordance with manufacturer's written instructions.

3.2 FUSES INSTALLATION

- A. Fuses: For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:
 1. 0 to 24: Provide 6 spare.
 2. 25 to 48: Provide 9 spare.
 3. 49 and Above: Provide 12 spare.

3.3 MOLDED CASE CIRCUIT BREAKERS INSTALLATION

- A. Provide testing of ground fault interrupting breakers.
- B. Provide circuit breakers, as specified and on Drawings, for installation in panelboards, individual enclosures or combination motor starters.
- C. Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.
- D. Provide device on handle to lock breaker in "ON" position for breakers feeding time switches, night lights and similar circuits required to be continuously energized.
- E. Shunt Trip Circuit Breakers: Provide wiring to remote trip switch/contacts as indicated on Drawings.
- F. Provide multi-pole branch circuit breakers for multiwire branch circuits for simultaneous disconnection of circuits.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Toggle Type Disconnect Switches
 - 2. Safety Switches
 - 3. Enclosed Circuit Breakers
 - 4. Molded Case Switches

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 73, Electrical Distribution System Studies
 - 2. Section 26 24 16, Panelboards
 - 3. Section 26 28 00, Overcurrent Protective Devices

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Toggle Type Disconnect Switches:
 - 1. Cooper
 - 2. Hubbell
 - 3. Leviton
 - 4. Legrand (Pass & Seymour)
 - 5. Slater
 - 6. Or approved equivalent.
- B. Safety Switches:
 - 1. Eaton Electrical
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D
 - 5. Or approved equivalent.
- C. Enclosed Circuit Breakers:

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1. Eaton Electrical
 2. ABB/General Electric
 3. Siemens
 4. Schneider Electric/Square D
 5. Or approved equivalent.
- D. Molded Case Switches:
1. Eaton Electrical
 2. ABB/General Electric
 3. Siemens
 4. Schneider Electric/Square D
 5. Or approved equivalent.
- 2.2 TOGGLE TYPE DISCONNECT SWITCHES
- A. Rating: 120 or 277 volt, 1 or 2 pole, 20 amp, 1 hp maximum.
- B. Enclosure:
1. NEMA 1: Dry locations/Indoors.
 2. NEMA 3R: Damp or wet locations/Outdoors.
- C. Handle lockable in "OFF" position.
- 2.3 SAFETY SWITCHES
- A. Heavy duty fusible type and non-fusible type (as indicated on drawings), dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.
- B. Clearly marked for maximum voltage, current, and horsepower.
- C. Operable handle interlocked to prevent opening front cover with switch in 'on' position.
- D. Switches rated for maximum available fault current.
- E. Handle lockable in "OFF" position.
- F. Enclosure:
1. NEMA 1: Dry locations/Indoors.
 2. NEMA 3R: Damp or wet locations/Outdoors.
- G. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Provide fuse rejection feature for Class R or J fuses up to 600 amp. Remove if circuit breaker type is used. Provide switches of 30 to 200 amp with plug-on line side connections.
- 2.4 ENCLOSED CIRCUIT BREAKERS
- A. Molded Case Circuit Breakers:
1. 1-, 2-, or 3-pole bolt on, single-handle common trip, 600VAC or 250VAC as indicated on Drawings.
 2. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
 3. Calibrate for operation in 40 degrees C ambient temperature.
 4. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
 5. 151 to 400 Amp Breakers: Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.
 6. Provide handle mechanisms that are lockable in the open (off) position.
 7. Circuit breakers to have minimum symmetrical interrupting capacity as indicated on Drawings.
- B. Enclosure:
1. NEMA 1: Dry locations/Indoors.
 2. NEMA 3R: Damp or wet locations/Outdoors.

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- 2.5 MOLDED CASE SWITCHES
- A. Removable cover, galvanized steel enclosure, powder coat painted.
 - B. Provide cover padlock provision.
 - C. Provide trip unit with no overcurrent, overload, or low level fault protection. Trip unit to be high instantaneous magnetic fixed trip type with magnetic trip reset at factory to interrupt high fault currents at or above preset level.
 - D. Enclosure:
 - 1. NEMA 1: Dry locations/Indoors.
 - 2. NEMA 3R: Damp or wet locations/Outdoors.

PART 3 - EXECUTION

- 3.1 GENERAL INSTALLATION REQUIREMENTS
- A. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
 - B. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to switches, fuses and circuit breakers as necessary to coordinate with the nameplate rating.
 - C. Install in accordance with manufacturer's instructions.
 - D. Provide engraved nameplates per Section 26 05 53, Identification for Electrical Systems.
 - E. Provide arc flash labels per Section 26 05 73, Electrical Distribution System Studies.
 - F. Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed. Clearly label disconnects with panel and circuit.
- 3.2 TOGGLE TYPE DISCONNECT SWITCHES INSTALLATION
- A. Install products, systems and equipment in accordance with manufacturer's written instructions and requirements.
 - B. See General Installation Requirements above.
- 3.3 SAFETY SWITCHES INSTALLATION
- A. Install products, systems and equipment in accordance with manufacturer's written instructions and requirements.
 - B. Install fuses in fusible disconnect switches. Coordinate fuse ampere rating with installed equipment. Do not provide fuses of lower ampere rating than the motor starter thermal units.
 - C. See General Installation Requirements above.
- 3.4 ENCLOSED CIRCUIT BREAKERS INSTALLATION
- A. Install products, systems and equipment in accordance with manufacturer's written instructions and requirements.
 - B. See General Installation Requirements above.
- 3.5 MOLDED CASE SWITCHES INSTALLATION
- A. Install products, systems and equipment in accordance with manufacturer's written instructions and requirements.
 - B. See General Installation Requirements above.

END OF SECTION

SECTION 26 51 00
LIGHTING

SECTION 26 51 00 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Luminaires
 - 2. LED Drivers
 - 3. Lamps
 - 4. Emergency LED Luminaire Power Supply
- B. Provide wiring for complete and operating lighting system.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NECA 500 - Commercial Lighting.
 - 2. UL 8750 - Light Emitting Diode (LED) equipment for use in lighting products.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Submit product data for:
 - a. LED Luminaires: Electrical ratings, dimensions, mounting, material, clearances, terminations, wiring, connection diagram, LM-79 photometric data, LM-80 lumen depreciation data.
 - b. LED Drivers
 - c. Lamps
 - d. Emergency LED Luminaire Power Supply
 - 2. Submittal Cutsheets: Highlight, circle or otherwise graphically indicate which option(s) are being selected for the products submitted. Cutsheets that are not edited to indicate which products and options are submitted for this project or that list only catalog numbers to identify submitted options are not acceptable.
 - 3. Specified manufacturers are approved to submit bid. However, inclusion does not relieve manufacturer from supplying product as described.
 - 4. Provide the following operating and maintenance instructions as required by Section 26 00 00, Electrical Basic Requirements:
 - a. Luminaires
 - b. LED Drivers
 - c. Lamps
 - d. Emergency LED Luminaire Power Supply

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Provide luminaires acceptable to code authority for application and location installed.

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2. Comply with applicable ANSI standards.
3. Comply with applicable NEMA standards.
4. Provide luminaires and lampholders that comply with UL standards and have been listed and labeled for location and use indicated by a testing agency acceptable by the AHJ (e.g., UL, ETL, and the like).
5. Comply with OESC as applicable to installation and construction of luminaires.
6. Comply with fallout and retention requirements of OSSC for diffusers, baffles, and louvers.
7. Provide LED luminaires from the same manufacturer and manufacturing LED source batch for similar applications (e.g., all LED downlights from a single manufacturer and batch, all linear LED products from single manufacturer and batch).

1.6 WARRANTY

- A. Warranty as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 1. LED Luminaire Manufacturer's Warranty: Not less than 5 years for luminaire based on date of substantial completion. Includes normal cost of labor to replace luminaire. Replacement luminaire will match physical dimensions, physical appearance, chromaticity, lumen output and photometric characteristics of original installed equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Luminaires:
 1. Reference description and manufacturers in Luminaire Schedule on Drawings.
 2. Or approved equivalent.
- B. LED Drivers:
 1. Indoor Drivers:
 - a. General Electric
 - b. Advance/Philips
 - c. Osram Sylvania
 - d. Or approved equivalent.
 2. Outdoor Drivers:
 - a. Advance/Philips
 - b. Osram Sylvania
 - c. General Electric
 - d. Or approved equivalent.
- C. Lamps:
 1. LED (Light Emitting Diode) Lamps:
 - a. Acuity/Lithonia Eaton/Cooper ETC Philips
 - b. Eaton/Cooper
 - c. ETC
 - d. Philips
 - e. Or approved equivalent.
 2. Unless specific manufacturer not shown on this list is indicated in the Luminaire Schedule.
 3. Special types as indicated in Luminaire Schedule.
 4. Or approved equivalent.
- D. Emergency LED Luminaire Power Supply:
 1. Bodine
 2. Hatch

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3. Fulham
4. Myers
5. Isolite
6. Or approved equivalent.

2.2 LUMINAIRES

- A. Luminaires: Reference description and manufacturers in Luminaire Schedule on Drawings.
- B. Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.
- C. UL label luminaires installed under canopies, roof or open porches, and similar damp or wet locations, as suitable for damp or wet location.
- D. Suspended luminaires: Provide minimum 24-inch adjustability in aircraft cable length where used.
- E. Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material. Verify with Architectural Reflected Ceiling Plan prior to submittals.
- F. Finishes:
 1. Manufacturer's standard finish (unless otherwise indicated) over corrosion resistant primer.
 2. Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectance.
 3. Exterior Finishes: As detailed in Luminaire Schedule or on Drawings. Refer cases of uncertain applicability to Architect for resolution prior to release for fabrication.
- G. Light Transmitting Components:
 1. Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
 2. Prismatic acrylic, extruded, flat diffusers, 0.125-inch overall thickness, unless otherwise noted.
- H. LED Luminaires:
 1. UL listing of luminaire includes drivers, transformers, enclosures, rated wire, communications devices and accessories needed for a complete and functional system.
 2. LM-79: Testing and measurement of absolute photometry, chromaticity (CCT) and luminaire power. Report provided by DOE certified independent testing laboratory. CCT as specified in Luminaire Schedule.
 3. Standards: ANSI C78.377, LM-79 and LM-82 compliant for performance characteristics, photometry, colorimetry, efficacy and thermal characteristics.
 4. LM-80 + TM-21: Testing and measurement, and statistical prediction of LED lamp life. Report provided by DOE certified independent testing laboratory.
 5. LEDs in one module/luminaire: Supplied from same batch/bin and fall within 3-step MacAdam Ellipse, or as described in Luminaire Schedule, whichever is the more stringent requirement.
 6. Provide luminaires with integral LED thermal management system (heat sinking).
 7. Luminaires to be equipped with an LED driver that accepts 120V through 277V, 50Hz to 60Hz (universal). Component-to-component wiring within the luminaire will carry no more than 80 percent of rated current and be listed by UL for use at 600VAC at 302 degrees F/150 degrees C or higher. Plug disconnects to be listed by UL for use at 600VAC, 15A or higher.
 8. Provide luminaires with individual LED arrays/modules and drivers that are accessible and replaceable from exposed side of the luminaire.

2.3 LED DRIVERS

- A. General:

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1. Performance: Meet dimming range called out in Luminaire Schedule, free from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
 2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
 3. Minimum efficiency of 85 percent, power factor greater than or equal to 0.90, compliance with reduction of hazardous substances (RoHS). Rated for operating temperature range of area in which driver is installed.
 4. Limit inrush current to minimize breaker tripping.
 - a. Base specification: NEMA 410 standard for inrush current for electronic drivers.
 - b. Preferred Specification: Meet or exceed 30 milliamp-squared-seconds at 277VAC for up to 50 watts of load and 75 amps at 240 microseconds at 277VAC for 100 watts of load.
 5. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
 6. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
 7. Total Harmonic Distortion less than 10 percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD at no point in the dimming curve allows imbalance current to exceed full output THD.
 8. Support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
 - a. Adjustment of forward LED voltage, supporting 3V through 55V.
 - b. Adjustment of LED current from 150mA to 1.4A at the 100 percent control input point in increments of 1mA.
 - c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
 9. Operate for a (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.
 10. UL Recognized under the component program and modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
 11. Ability to provide no light output when the analog control signal drops below 0.3 V, or the DALI/DMX digital signal calls for light to be extinguished and consume 0.5 watts or less in this standby. Control dead band between 0.3V and 0.65V included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.
- B. Light Quality:
1. Over the entire range of available drive currents, driver to provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0 percent relative light output, or 100 percent to 1 percent light output and step to 0 percent where indicated. Driver to respond similarly when raising from 0 percent to 100 percent.
 - a. Driver must be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.
 2. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
 3. Drivers to track evenly across multiple luminaires at all light levels, and must have an input signal to output light level that allows smooth adjustment over the entire dimming range.
 4. Driver and luminaire electronics to deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all

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points within the dimming range from 100 percent to 0.1 percent luminaire will have:

- a. LED dimming driver to provide continuous step-free, flicker free dimming similar to incandescent source.
 - b. Base specification: Based on IEEE PAR1789, minimum output frequency should be greater than 1250 Hz.
 - c. Preferred specification: Flicker index to be equal to incandescent, less than 1 percent at all frequencies below 1000 Hz.
- C. Control Input:
1. Provide control protocol to match lighting control system specified for use with luminaire.
 2. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
 - a. Meet IEC 60929 Annex E for General White Lighting LED drivers.
 - b. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
 - c. Meet ESTA E1.3 for RGBW LED drivers.

2.4 LAMPS

- A. Provide lamps for luminaires.
- B. Provide lamp catalogued for specified luminaire type.
- C. Incandescent Lamps: Not allowed unless noted in Luminaire Schedule.
- D. LED (Light Emitting Diode):
 1. LED manufacturer will include, but not be limited to, light source, luminaire, power supply and control interface with added components as needed for complete and functioning system.
 - a. Comply with ANSI chromaticity standard for classifications of color temperature. See Luminaire Schedule for specified LED lamp color and color temperature. UL or ETL listed and labeled.
 - b. Luminaire testing per IESNA LM-79 and LM-80 procedures.
 - c. Lamp life for white LEDs: 50,000 plus hours with lamp failure occurring when LED produces 70 percent of initial rated lumens.
 - d. Lamp life for color LEDs: 30,000 plus hours with lamp failure occurring when LED produces 50 percent of its initial rated lumens.
 - e. LED Drivers: Reverse polarity protection, open circuit protection, require no minimum load. Minimum 80 percent efficiency. Class A noise rating.
 - f. Dimming: LED system capable of full and continuous dimming.
 - g. Correlated Color Temperature (CCT): See Luminaire Schedule for selection of color temperature for each luminaire. Ranges given below reflect maximum allowable tolerances for color temperature range for each nominal CCT.
 - 1) Nominal CCT:
 - (a) 2700 K (2725 ± 145)
 - (b) 3000 K (3045 ± 175)
 - (c) 3500 K (3465 ± 245)
 - (d) 4000 K (3985 ± 275)
 - h. Color Rendering Index (CRI) to be greater than or equal to 80.
 2. Special types as indicated in Luminaire Schedule.

2.5 EMERGENCY LED LUMINAIRE POWER SUPPLY

- A. Internal Type: Self-contained, modular, battery unit, factory mounted within luminaire body and compatible with driver. Comply with UL 924.
 1. Emergency Connection: Operate one LED module continuously at a minimum output of 1400 lumens each. Connect unswitched circuit to battery unit and

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- switched circuit to luminaire driver.
- 2. 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. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- 3. Battery: Sealed, maintenance-free, nickel-cadmium type. Sized for a minimum output of 90 minutes.
- 4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
- B. External Type: Self-contained, modular, battery unit, suitable for powering one or more LED modules, remote mounted from luminaire. Comply with UL 924.
 - 1. Emergency Connection: Operate one LED module continuously. Connect unswitched circuit to battery unit and switched circuit to luminaire driver.
 - 2. Charger: Fully automatic, solid-state, constant-current type.
 - 3. Housing: NEMA 250, Type 1 enclosure.
 - 4. Test Push Button: Visible and accessible without entering ceiling space.
 - a. Push-to-test type, in remote unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - c. Faceplate Finish: Verify finish with Architect for each room prior to ordering materials.
 - 5. Battery: Sealed, maintenance-free, nickel-cadmium type. Sized for a minimum output of 90 minutes.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install per manufacturer's written installation instructions and requirements.
- B. Install luminaires securely, in neat and workmanlike manner.
- C. Install luminaires of types indicated where shown and at indicated heights in accordance with manufacturer's written instructions and with recognized industry practices to ensure that luminaires comply with requirements and serve intended purposes.
- D. Wiring:
 - 1. Recessed luminaires to be installed using flexible metallic conduit or MC Cable as allowed by Section 26 05 19 with luminaire conductors spliced to branch circuit conductors in nearby accessible junction box over ceiling. Junction box fastened to building structural member within 6-feet of luminaire.
 - 2. Luminaires for lift out and removal from ceiling pattern without disconnecting conductors or defacing ceiling materials.
 - 3. Flexible connections where permitted to exposed luminaires; neat and straight, without excess slack, attached to support device.
 - 4. Install junction box, flexible conduit and high temperature insulated conductors for through wiring of recessed luminaires.
- E. Relamp luminaires which have failed lamps at substantial completion.
- F. Replace LED drivers deemed as excessively noisy by Architect, Engineer, or Owner.
- G. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- H. Support luminaires larger than 2- by 4-foot size independent of ceiling framing.
- I. Locate recessed ceiling luminaires as indicated on architectural reflected ceiling plan.
- J. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

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- K. Exposed Grid Ceilings:
 - 1. Support surface mounted luminaires in grid ceiling directly from building structure.
 - 2. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
 - 3. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- L. Install recessed luminaires to permit removal from below.
- M. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- N. Install clips to secure recessed grid-supported luminaires in place.
- O. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Architectural Drawings.
- P. Install accessories furnished with each luminaire.
- Q. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- R. Bond products and metal accessories to branch circuit equipment grounding conductor.
- S. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
- T. Where manufactured wiring assemblies are used, ensure that wiring assembly manufacturer sends components to appropriate luminaire manufacturer for respective installation of proper components.
- U. Coordination:
 - 1. Coordination of Conditions: Coordinate ceiling construction, recessing depth and other construction details prior to ordering luminaires for shipment. Refer cases of uncertain applicability to Architect for resolution prior to release of luminaires for shipment. Where luminaires supplied do not match ceiling construction, replace luminaires at no cost to Owner.
 - 2. Electrical drawings are schematic, identifying quantity and type of luminaires used and their approximate location, but are not to be used for dimensional purposes. Reference architectural drawings for exact locations, including mounting heights.
 - 3. Provide lighting indicated on Drawings with luminaire of the type designated and appropriate for location.
 - 4. Provide LED luminaires with driver compatible to lighting control system as shown in drawings and as specified.
 - 5. Where remote drivers are required, ensure adequate accessibility to driver. Upsize conductors between luminaire and driver to accommodate voltage drop.
- V. Field Quality Control:
 - 1. Perform field inspection in accordance with Division 01, General Requirements.
 - 2. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- W. Cleaning:
 - 1. Clean electrical parts to remove conductive and deleterious materials.
 - 2. Remove dirt and debris from enclosures.
 - 3. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.
 - 4. Clean photometric control surfaces as recommended by manufacturer.
 - 5. Clean finishes and touch up damaged finishes per by manufacturer's instructions.
- X. Demonstrate luminaire operation for minimum of two hours.

3.2 LUMINAIRES INSTALLATION

- A. Install per manufacturer's written installation instructions and requirements.
- B. Align, mount and level luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.
- C. Avoid interference with and provide clearance from equipment. Where indicated locations for luminaires conflict with locations for equipment, change locations for luminaire by

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- minimum distance necessary as directed by Architect.
- D. Suspended Luminaires: Mounting heights indicate clearances between bottom of luminaire and finished floors.
 - E. Emergency Egress Luminaires: Provide unswitched circuit for battery charging and autotransfer circuiting for exit signs and luminaires with integral batteries or external microinverters. Where test switch cannot be integral to luminaire, mount remote test switch flush-to-ceiling and adjacent to egress luminaire.
 - F. Interior Luminaire Supports:
 - 1. Support Luminaires: Anchor supports to structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Maintain luminaire positions after cleaning and relamping.
 - 3. Support luminaires without causing ceiling or partition to deflect.
 - 4. Provide mounting supports for recessed and pendant mounted luminaires as required by OSSC.
 - G. Adjusting:
 - 1. Aim and adjust luminaires as indicated.
 - 2. Focus and adjust floodlights, spotlights and other adjustable luminaires, with Architect, at such time of day or night as required.
 - 3. Align luminaires that are not straight and parallel/perpendicular to structure.
 - 4. Position exit sign directional arrows as indicated.
- 3.3 LED DRIVERS INSTALLATION
- A. Install lamps per manufacturer's installation instructions and requirements.
 - B. Where driver is remote mounted, size wiring based on type of driver, driver distance from luminaire, and voltage/power level, and manufacturer's installation instructions.
 - C. Protect 0-10V input from line voltage mis-connection, and so it will be immune and the output unresponsive to induced AC voltage on the control leads.

END OF SECTION

**SECTION 33 46 00
SUBDRAINAGE**

SECTION 33 46 00 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Perforated-wall pipe and fittings.
 - 2. Geotextile filter fabrics.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Perforated-wall pipe and fittings.
 - 2. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

- A. PE Pipe and Fittings:
 - 1. ASTM F405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
 - a. Perforated and non-perforated types.
 - 2. NPS 8 and Larger: ASTM F667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
 - a. Perforated and non-perforated types.
 - 3. Couplings: Manufacturer's standard, band type.

2.2 ACCESSORIES

- A. Tracer Wire: 18 AWG, insulated, green.

2.3 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested in accordance with ASTM D4491.
- B. Structure Type: Nonwoven, needle-punched continuous filament.
 - 1. Survivability: AASHTO M 288 Class 2.
 - 2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. If applicable, verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FOUNDATION DRAINAGE INSTALLATION

- A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

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- D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.
- E. Install perforated drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.
- F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
- G. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.
- H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- J. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.3 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions and other requirements indicated.
 - 1. Foundation Subdrainage: Install piping level and with a minimum cover of 24 inches unless otherwise indicated.
 - 2. Lay perforated pipe with perforations down.
 - 3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install thermoplastic piping in accordance with ASTM D2321.

3.4 PIPE JOINT CONSTRUCTION

- A. Join perforated PE pipe and fittings with couplings in accordance with ASTM D3212 with loose banded, coupled, or push-on joints.
- B. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.5 BACKWATER VALVE INSTALLATION

- A. Comply with requirements for backwater valves specified in Division 33 "Utilities."
- B. Install horizontal backwater valves in header piping downstream from perforated subdrainage piping.
- C. Install horizontal backwater valves in piping in manholes or pits. Coordinate location with Architect.

3.6 CLEANOUT INSTALLATION

- A. Comply with requirements for cleanouts specified in Division 33 "Utilities."
- B. Cleanouts for Foundation Subdrainage:
 - 1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
 - 2. In vehicular-traffic areas, use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches deep. Set top of cleanout flush with grade.
 - 3. In nonvehicular-traffic areas, use NPS 4 cast-iron pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches deep. Set top of cleanout 2 inches above grade.
 - 4. Comply with requirements for concrete specified in Section 03 30 00 "Cast-in-Place Concrete."

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3.7 CONNECTIONS

- A. Comply with requirements for piping specified in Division 33 "Utilities." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system. Coordinate connection point with Civil work.

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
 - 2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.
- B. Drain piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION