

# Project Manual



## NEWBERRY COUNTY PROSPERITY PARK IMPROVEMENTS

### Architect's Project Numbers:



23235-A North Main Park  
23235-B Town Center Park  
23235-C Langford Park  
23235-D Town Square

Issue Date:  
4 September 2025

**DP3**  
ARCHITECTS

**SECTION 00 01 07  
SEALS PAGE**

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ELECTRICAL ENGINEER:	<p><b>Shannon L. Epps, PE</b>  DeVita &amp; Associates, Inc.  33 Villa Road, Suite 300  Greenville, SC 29615</p> <p>[P] 864.232.6642</p>	 <p>31 JUL 2025</p>	 <p>31 JUL 2025</p>

<p>MECHANICAL &amp; PLUMBING ENGINEER:</p>	<p><b>Emily L.B. Ziegler, PE</b> DeVita &amp; Associates, Inc. 33 Villa Road, Suite 300 Greenville, SC 29615</p> <p>[P] 864.232.6642</p>	 <p>31 JUL 2025</p>	 <p>31 JUL 2025</p>
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INVITATION TO BID**

Newberry County (Agency) is soliciting sealed bids from qualified contractors for improvements to four park sites located in Prosperity, SC 29127. The four sites are as follows. North Main Park located at North Main and Shiloh Street, Town Center Park located at 250 School Drive, Langford Park located at 304 Langford Street, and Town Square located at Main Street and Grace Street.

This solicitation is intended to promote competition. If any language, specifications, terms and conditions, or any combination thereof restricts or limits the requirements in this solicitation to a single source, it shall be the responsibility of the interested vendor to notify the Purchasing Director in writing within five (5) days prior to the opening date. The solicitation may or may not be changed but a review of such notification will be made prior to the award.

For a complete bid package, please visit:

<https://www.newberrycounty.gov/purchasing/solicitations>

**Important Dates:**

**MANDATORY PRE-BID MEETING:**

**Tuesday, September 30, 2025 10:00 AM**

**Pre-Bid Meeting Location:**

**Prosperity Civic Center  
250 School Drive  
Prosperity, SC 29127**

**WRITTEN QUESTIONS DUE:**

**Thursday, October 23, 2025 5:00 PM**

**BID DUE DATE:**

**Tuesday, November 4, 2025 3:00 PM**

**COUNCIL AWARD**

**Wednesday, November 19, 2025**

**Due Date:**

Please submit one (1) sealed packets to the address listed below using the following Bid Envelope Label. At the call of time, the bids will be opened and publicly read aloud. Faxed, e-mailed, or late bids will not be considered. Mail or hand-deliver to:

Newberry County  
Attn: Crystal Waldrop  
1309 College Street  
P.O. Box 156  
Newberry, SC 29108  
Phone: 803.321.2100

**BID ENVELOPE LABEL:**

**NEWBERRY COUNTY – PROSPERITY PARK  
IMPROVEMENTS**

**GENERAL CONTRACTOR'S NAME**

**GENERAL CONTRACTOR'S ADDRESS**

**COUNTY BID NUMBER: 2025-17**

**DATE OF SUBMISSION**

**Bidder Responsibilities and Requirements:**

All prospective bidders must participate in a Pre-Bid meeting. The Pre-Bid meeting shall be at the location listed above. **Failure to attend this meeting shall be grounds for rejection of bid.**

Deadline for questions is listed in the Important Dates above.

Questions shall be sent in writing by e-mail to Laurel Getty at [lgetty@dp3architects.com](mailto:lgetty@dp3architects.com) and copied to Adam Failla at [adam@claytonconstruction.net](mailto:adam@claytonconstruction.net).

Prices submitted are valid for **60 days**.

**Project Description:**

The Total Project includes improvements to four park sites as described below.

North Main Park improvements include demolition of an existing structure, upgrades to two existing gravel parking lots including new concrete accessible parking spaces and sidewalks, and a new 1,900 SF amenity structure to house a concessions kitchen, multi-fixture restrooms, a field office, a storage room, and a covered picnic area.

Town Center Park improvements include a new 580 SF amenity structure to house three accessible restrooms and a storage room; upgraded multipurpose field lighting, and light pedestals along walking trail.

Langford Park improvements include a new 1,100 SF amenity structure to house three accessible restrooms, a storage room, and a covered picnic area; upgrades to an existing gravel parking lot including new concrete accessible parking spaces and sidewalks, and new chain link fence and gates around the existing basketball court.

Town Square improvements include a new 450 SF manufactured open air steel structure, brick paver plaza, water feature, miscellaneous electrical upgrades, new park benches/swings, and new landscaping and irrigation.

Construction disciplines required for the project include, but are not limited to:

Site work:	Excavation, rough and finish grading, branch utilities, paving
Concrete:	Cast in place
Masonry:	Unit masonry assemblies
Metals:	Miscellaneous steel. Standing seam roof panels and trim.
Wood & Plastics:	Rough and finish wood carpentry and trim
Thermal & Moisture Protection:	Weather barrier and insulation
Doors & Windows:	Hollow metal doors and frames.
Finishes:	Gypsum board assemblies, paint.
Specialties:	Toilet accessories
Equipment:	None
Furnishings:	None

Special Construction:	Manufacture open air steel structure
Conveying systems:	None
Plumbing:	Standard ADA
Mechanical:	Standard
Electrical:	Standard
Sprinkler System:	None

**SECTION 00 21 13  
INSTRUCTIONS TO BIDDERS**

**PART 1 GENERAL**

- 1.01** Only one copy of bid is required unless otherwise specified.
- 1.02** Bids, amendments thereto or withdrawal request must be received by the time advertised for bid openings to be timely filed. It is the vendor's sole responsibility to ensure that these documents are received by the purchasing office at the time indicated in the bid document.  
**PLEASE NOTE THE VENDOR IS ULTIMATELY RESPONSIBLE FOR VERIFYING THEY HAVE RECEIVED ANY/ALL ADDENDA FROM THE COUNTY WEBSITE PRIOR TO THE BID SUBMITTAL.**
- 1.03** When specifications or descriptive papers are submitted with the bid, enter bidder's name thereon.
- 1.04** Submit your signed bid on the bidder's schedule provided. Show bid number on envelope as instructed and the bid name or description. Newberry County accepts no responsibility for unmarked or improperly marked envelopes.
- 1.05** Bidders must clearly mark as "Confidential" each part of their bid which they consider to be proprietary information that could be exempt from disclosure under Section 30-4-40 Code of Laws of South Carolina, 1976, as amended, (also known as the Freedom of Information Act). The County reserves the right to determine whether this information should be exempt from disclosure and no legal action may be brought against the County or its agents for its determination in this regard.
- 1.06** By submission of a bid, you are guaranteeing that all goods and services meet the requirements of the solicitation during the contract period.
- 1.07** Tie bids will be resolved in accordance with the provisions of the Newberry County Purchasing Ordinance.
- 1.08** A copy of the bidder's W-9 shall be included in the submission.

**PART 2 GENERAL PROVISIONS**

- 2.01** The County of Newberry reserves the right to reject any and all bids, to cancel a solicitation, and to waive any technicality if deemed to be in the best interest of the County.
- 2.02** Unit prices will govern over extended prices unless otherwise stated in this bid invitation.
- 2.03** PROHIBITION OF GRATUITIES:  
A. South Carolina Law and the Newberry County Purchasing Ordinance prohibit the giving of anything of value in return for favors or other preferential treatment in the purchasing process. Bidders should govern themselves accordingly.
- 2.04** BIDDERS QUALIFICATION:  
A. Bidders must, upon request of the county, furnish satisfactory evidence of their ability to furnish products or services in accordance with the terms and conditions of these specifications. The county reserves the right to make the final determination as to the bidder's ability to provide the products or services requested herein. Bidder determined to be irresponsible bidders are not allowed to bid to provide the county goods or services.
- 2.05** BIDDERS RESPONSIBILITY:  
A. Each bidder shall fully acquaint himself with conditions relating to the scope and restrictions attending the execution of the work under the conditions of this bid. It is expected that this will sometimes require on-site observation. The failure or omission of a bidder to acquaint

himself with existing conditions shall in no way relieve him of any obligation with respect to this bid or to the contract.

**2.06 AWARD CRITERIA:**

- A. The contract shall be awarded to the lowest responsible and responsive bidder(s) whose bid meets the requirements and criteria set forth in the invitation for bid. Award may be made to one or a multiple of bidders, whichever deems to be in the best interest of the county, or unless otherwise stated on the bidder's schedule.

**2.07 WAIVER:**

- A. The county reserves the right to waive any instruction to bidders, general or special provisions, general or special conditions, or specifications deviation if deemed to be in the best interest of the county.

**2.08 COMPETITION:**

- A. This solicitation is intended to promote competition. If any language, specifications, terms and conditions, or any combination thereof restricts or limits the requirements in this solicitation to a single source, it shall be the responsibility of the interested vendor to notify the Purchasing Director in writing within five (5) days prior to the opening date. The solicitation may or may not be changed but a review of such notification will be made prior to the award.

**2.09 REJECTION:**

- A. Ambiguous bids which are uncertain as to terms, delivery, quantity, or compliance with specifications may be rejected or otherwise disregarded if such action is in the best interest of the County.

**2.10 RIGHT TO PROTEST:**

- A. Any prospective bidder, offeror, or contractor, who is aggrieved in connection with the solicitation of a contract shall protest in writing to the purchasing director within ten (10) calendar days of the date of issuance of the invitation to bid or other solicitation documents, whichever is applicable, or any amendment thereto, if the amendment is at issue. Any actual bidder, offeror, or contractor, who is aggrieved in connection with the intended award or award of a contract, shall protest in writing to the purchasing director within ten (10) calendar days of the notification of intent to award or statement of award.

**2.11 PROTEST PROCEDURE:**

- A. A protest shall be in writing, submitted to the purchasing director, and shall set forth the specific grounds of the protest with enough particularity to give notice to the issues to be decided.

**PART 3 GENERAL CONDITIONS**

**3.01 DEFAULT:**

- A. In case of default by the contractor, the County reserves the right to purchase any or all items in default in the open market, charging the contractor with any excessive costs. Should such charge be assessed, no subsequent bids of the defaulting contractor will be considered until the assessed charge has been satisfied.

**3.02 NON-APPROPRIATION**

- A. Any contract entered into by the County resulting from this bid invitation shall be subject to cancellation without damages or further obligation when funds are not appropriated or otherwise made available to support continuation of performance in a subsequent fiscal period or appropriated year.

**3.03 HOLD HARMLESS AND INSURANCE**

- A. The successful bidder shall indemnify and hold harmless the County of Newberry and all County officers, agents and employees against all suits or claims for personal injury or property damage resulting from, or arising from, the successful bidder's performance of the contract, as well as against any suits or claims of any character brought against the County or its agents or employees by reason of any claim of infringement of any patent, trade mark, trade dress, or copyright, including reimbursement to the County for all attorneys fees and court costs incurred by the County in defending itself or its agents or employees against any such claim or suit. In addition, the successful bidder will maintain a public liability policy with minimum limits of \$500,000 per occurrence, or \$1,000,000 single limit, for damages arising from acts which occur during the contract period, with the County of Newberry named as an additional insured on the policy; the successful bidder shall also maintain workers compensation and vehicle liability insurance in the amounts required by statutory law. Proof of such coverage will be provided upon demand or as otherwise provided in the bid specifications

**3.04 CONTRACT ADMINISTRATION:**

- A. Questions or problems arising after award of this contract shall be directed to the Purchasing Director, P.O. Box 156, Newberry, SC 29108, or by calling 803-321-2100.

**3.05 FORCE MAJEURE:**

- A. The Contractor shall not be liable for any excess costs if the failure to perform the contract arises out of causes beyond the control and without fault or negligence of the contractor. Such causes may include, but are not restricted to acts of God or of a public enemy, acts of Government in either its sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; but in every case the failure to perform must be beyond the control and without the fault or negligence of the contractor. If the failure to perform is caused by default of a subcontractor, and if such default arises out of causes beyond the control of both the contractor and subcontractor and without excess costs for failure to perform, unless the supplies or services to be furnished by the subcontractor were obtainable from other sources in sufficient time to permit the contractor to meet the required delivery schedule.

**3.06 PUBLIC RELEASE:**

- A. Contractor agrees not to refer to award of this contract in commercial advertising in such a manner as to state or imply that the products or services provided are endorsed or preferred by the User.

**3.07 QUALITY OF PRODUCT:**

- A. Unless otherwise indicated in this bid it is understood and agreed that any items offered or shipped on this bid shall be new, in first class condition, and without defect that all containers shall be new and suitable for storage or shipment, and that prices include standard commercial packaging and shipping to the specified destination in Newberry County. No demonstration models shall be sold as new, without prior written permission of the County.

**3.08 S.C. LAW CLAUSE:**

- A. Upon award of a contract under this bid, the person, partnership, association or corporation to whom the award is made must comply with the Laws of South Carolina which require such person or entity to be authorized and/or licensed to do business with this State. Notwithstanding the fact that applicable statutes may exempt or exclude the successful bidder from requirements that it be authorized and/or licensed to do business in this State, by submission of this signed bid, the bidder agrees to subject himself to the jurisdiction and process of the courts of the State of South Carolina as to all matters and disputes arising or to arise under the contract and the performance thereof, including any questions as to the



liability for taxes, licenses, or fees levied by the State.

**3.09 ASSIGNMENT:**

- A. No contract or its Provisions may be assigned, sublet, or transferred without the written consent of the Purchasing Director.

**3.10 AFFIRMATIVE ACTION:**

- A. The successful bidder will take affirmative action in complying with all Federal and State requirements concerning fair employment of the handicapped, and concerning the treatment of all employees, without regard or discrimination by reason of race, color, religion, sex, national origin or physical handicap.

**3.11 DELIVERIES:**

- A. All deliveries shall be FOB Destination. It is agreed by the parties hereto that delivery by the contractor to the common carrier does not constitute delivery to the County. Any claim for loss or damage shall be between the contractor and the carrier.

**3.12 APPROPRIATE S.C. SALES TAXES, FEES, AND PERMITS:**

- A. Appropriate S.C. sales taxes, fees, and permits shall be included in the Contractor's base bid for all materials. All fees, including permits and any removal or disposal of construction debris shall be included in the contractor's bid.

**3.13 PAYMENT TERMS:**

- A. Payment will be in accordance with Section 01 20 00 Price and Payment Procedures.

**3.14 BID BOND:**

- A. For each bid in excess of \$25,000.00 each bidder will submit with their bid a bond in the amount of 5% of the total price of the bid submitted. The bid bonds will be returned to the unsuccessful bidders once the County accepts the lowest most responsive bid. If the most responsive bidder fails to perform the responsibility of the bid within 10 days of the award, then the bid bond will be forfeited to the county as liquidated damages and the next lowest bidder will be awarded the bid.
- B. Bid bonds may be in the form of a surety, a cashier's check or an unconditional letter of credit in favor of Newberry County issued by a commercial bank in South Carolina.
  - 1 Acceptable surety formats include the *Bid Bond* document included in the Bid Form, AIA Document A310-2010, or the surety companies standard bond certificate.
  - 2 Bonds executed by an Attorney-In-Fact shall have attached to each copy of the bond a certified copy of Power of Attorney properly executed and dated.

**3.15 PERFORMANCE AND PAYMENT BONDS:**

- A. The chosen vendor will be required to submit to the County both a performance bond and payment bond in the amount of 100% of the contract price as part of the Contract documents required to execute the contract prior to commencing with the work.
- B. **Both bonds will be issued from a surety company with an "A" minimum rating of performance as stated in the most current publication of Best Key Rating Guide, Property Liability. Performance Bonds are required when the project is expected to cost \$100,000.00 or more. Payment Bonds are required when the project is expected to cost more than \$50,000.00.**
- C. Proof of ability to provide both bonds is required to be submitted with their bid.
  - 1 Acceptable formats include the *Performance and Payment Bond - Proof of Coverage* document included in the Bid Form or the surety companies standard bond certificate.
  - 2 Bonds executed by an Attorney-In-Fact shall have attached to each copy of the bond a

**SECTION 00 41 00  
BID FORM**

(Failure to furnish all requested data will be cause for considering Bidder non-responsive and may render this Bid invalid on that basis.)

BID FOR: **Bid #: 2025-17**  
**NEWBERRY COUNTY- PROSPERITY PARK IMPROVEMENTS (FOUR SITES)**  
NORTH MAIN PARK, N. MAIN & SHILOH STREETS, PROSPERITY, SC 29127  
TOWN CENTER PARK, 250 SCHOOL DRIVE, PROSPERITY, SC 29127  
LANGFORD PARK, 204 LANGFORD STREET, PROSPERITY, SC 29127  
TOWN SQUARE, MAIN & GRACE STREET, PROSPERITY, SC 29127

SUBMITTED TO:  
NEWBERRY COUNTY  
ATTN: CRYSTAL WALDROP  
1309 COLLEGE STREET  
P.O. BOX 156  
NEWBERRY, SC 29108

SUBMITTED BY:

\_\_\_\_\_  
*Address:*

\_\_\_\_\_  
*City, State, and Zip Code:*

This bid included addenda numbered and dated (if none, so state):

#	_____	_____
#	_____	_____
#	_____	_____
#	_____	_____
#	_____	_____

**BASE BID**

The proposed Contract Price is \_\_\_\_\_ dollars.  
(\$ \_\_\_\_\_)

**ALTERNATE NO. 1: ADD – NORTH MAIN PARK (23235-A) – PROVIDE LIGHT DUTY ASPHALT PAVEMENT AT PARKING LOTS IN LIEU OF GRAVEL PAVEMENT**

The proposed Contract Price is \$\_\_\_\_\_ dollars.  
(\$ \_\_\_\_\_)

**ALTERNATE NO. 2: ADD – LANGFORD PARK (23235-C) – PROVIDE LIGHT DUTY ASPHALT PAVEMENT AT PARKING LOT IN LIEU OF GRAVEL PAVEMENT**

The proposed Contract Price is \$\_\_\_\_\_ dollars.  
(\$ \_\_\_\_\_)

**ALTERNATE NO. 3: ADD – TOWN SQUARE (23235-D) – PROVIDE ALL IMPROVEMENTS SHOWN IN THE TOWN SQUARE DOCUMENT SET.**

The proposed Contract Price is \$\_\_\_\_\_ dollars.  
(\$ \_\_\_\_\_)

**GENERAL NOTES**

- A. The undersigned, hereinafter called Bidder, in compliance with the "Notice to Bidders," accepting all of the terms and conditions of the "Instructions to Bidders," including without limitation those dealing with the disposition of Bid Security; proposes and agrees, if awarded the Contract, to enter into an Agreement with the Owner in the form of Agreement included in the Contract Documents, to furnish all materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the work to be performed under this Contract within the Contract Time indicated in this Bid, in full and complete accordance with the shown, noted, described and reasonably intended requirements of the Contract Documents, to the full and entire satisfaction of the Owner, for the amounts contained in the Bid Schedules.
- B. This Bid will remain open for sixty 60 days after the day of Bid opening. If awarded a contract, Bidder will sign the Agreement and submit the Contract Security and other documents required by the Contract Documents within ten (10) days after the date indicated in Owner's Notice of Award.
- C. In submitting this Bid, Bidder represents that:
  - 1 Bidder has become thoroughly familiar with the terms and conditions of the proposed Contract Documents accepting the same as sufficient to indicate and convey understanding of all the conditions and requirements under the Contract which will be executed for the Work.
  - 2 Bidder has examined the site and locality where the Work is to be performed, the legal requirements (federal, state and local laws, ordinances, rules and regulations) and the conditions affecting cost, progress or performance of the Work and has made such independent investigations as Bidder deems necessary.
  - 3 This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for himself any advantage over any other Bidder or over Owner.
  - 4 That no member of the Commission or other officers or employees of said Owner is interested directly or indirectly in the Bid or in any portion of the Bid nor in the Contract or any part of the Contract which may be awarded the undersigned on the basis of such Bid.
  - 5 The description under each bid item, being briefly stated, implies, although it does not mention, all incidentals and that prices stated are intended to cover all such work, materials and incidentals as constitute Bidder's obligations as described in the Specifications, and any details not specifically mentioned, but evidently included in the Contract shall be compensated for in the item which most logically includes it.

6 The Bid includes all sales taxes and other applicable taxes and fees.

D. Contract Time: Bidder agrees that:

- 1 CONTRACTOR will commence work with an adequate force and equipment at the time stated in the Notice to Proceed, and complete all work in the number of days stipulated from the date stated in said notice without working overtime or on Saturdays, Sundays, or legal holidays except as specifically allowed by the Contract Documents and approved by the Owner.
- 2 Work shall commence no earlier than **December 8, 2025** or five (5) days after the receipt of the building permit, whichever is later, and the work shall be complete to the satisfaction of the owner within **210 calendar days**.
- 3 The following schedule depicts working days per calendar month (non-cumulative) that shall be anticipated as normal inclement weather. Such time will not be considered justification for an extension of time. Inclement weather days in excess of normal inclement weather days listed, are justification for extension of time. Inclement weather days on Saturday, Sunday and holidays will not be allowed unless work has been scheduled and the Architect notified prior to said days. Time extensions will be granted only if the critical path has been affected. Extensions of time will be calendar days and not working days. Requests for extensions of time shall be made, in writing, within 21 days of the event(s) giving rise to the request.

Inclement weather days are defined as days, before project "dry-in", in which weather is too cold or too wet for masonry work to occur, provided the critical path is affected. For a wet weather day to occur,  $\frac{1}{4}$ " of rain must fall during that day before 12:00 noon for it to be considered. Hot weather will not be justification for an inclement weather day.

January	6 days
February	5 Days
March	5 Days
April	4 Days
May	5 Days
June	4 Days
July	6 Days
August	7 Days
September	5 Days
October	4 Days
November	4 Days
December	5 Days

- 4 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not substantially complete within the times specified above. They also recognize the delays, expenses and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) items e and f below shall be enforced.
- 5 CONTRACTOR shall pay OWNER **Three Hundred Dollars (\$300)** for each calendar day that expires after the time specified above for completion and readiness for final payment.
- 6 CONTRACTOR understands and hereby expressly agrees that in addition to liquidated damages specified in Section 5 above, to pay the OWNER the actual costs to OWNER for any inspector or inspectors necessarily employed by OWNER on the Work until the Work

is completed and ready for final payment. Further, the CONTRACTOR agrees that the sums to be paid the OWNER may be deducted from the sum due the CONTRACTOR for work performed as provided in Article 14 of the General Conditions.

E. Execution of Contract: Bidder agrees that:

- 1 In case of failure on his part to execute the said Contract and Bonds within 15 days after the date indicated in the "Notice of Award", the check or bid bond accompanying this Bid, and the money payable thereon, shall be paid to the Owner as liquidated damages for such failure; otherwise, the Bid Bond or check accompanying this Bid shall be returned to the undersigned.

F. Bid Documentation: The following documents are to be submitted with the Bid Form and made a part of this Bid:

- 1 The undersigned acknowledges that **a Bid security (Bond), in an amount equal to at least 5% of the amount of the bid**, is required for all competitive sealed bidding for construction contracts when the price is estimated to equal to or exceed Twenty-Five Thousand Dollars (\$25,000.00). The Bid Bond shall be provided as indicated in the Invitation to Bid.
- 2 The undersigned acknowledges that **a Payment Bond, in an amount equal to 100% of the construction cost**, is required for all competitive sealed bidding for construction contracts when the price is estimated to equal to or exceed Fifty Thousand Dollars (\$50,000.00). Proof of coverage ability of the Payment Bond shall be provided as indicated in the Invitation to Bid.
- 3 The undersigned acknowledges that **a Performance Bond, in an amount equal to 100% of the construction cost**, is required for all competitive sealed bidding for construction contracts when the price is estimated to equal to or exceed One Hundred Thousand Dollars (\$100,000.00). Proof of coverage ability of the Performance Bond shall be provided as indicated in the Invitation to Bid.
5. Certificate of Insurance showing proof of required coverages.
6. Bidder's Affidavit.
7. Non-collusion Affidavit.
8. NEWBERRY COUNTY requires a copy of the bidder's W-9.

G. Name, business address (mailing and street) phone number and e-mail address of Bidder to which all formal Notices shall be sent:

Name \_\_\_\_\_  
Address \_\_\_\_\_  
\_\_\_\_\_

City, State, Zip

Phone Number

E-mail

- H. The terms used in this Bid, which are defined in the General Provisions of the Construction Contract included as a part of the Contract Documents, have the meanings assigned to them in the General Provisions.
- I. The undersigned, as Bidder, declares that he has examined the project and informed himself fully in regard to all conditions pertaining to this project; that he has examined the Drawings and Project Manual for the work and Contractual Documents relative thereto and that he has satisfied himself relative to the work to be performed.
- J. Adjustments To Base Bid:  
The OWNER may elect to award only a portion of the project at the prices provided by the successful Bidder.
- K. The Bidder agrees that his proposal may not be withdrawn for a period of 60 calendar days after the scheduled closing time for receiving bids.
- L. The Bidder acknowledges by his signature that the Owner reserves the right to reject any or all bids and to waive informalities in the bidding.
- M. The undersigned agrees to submit, **within twenty-four (24) hours of the bid due date**, the attached Schedule of Values Form, completed in its entirety, as part of the Bid Submittal. Such Schedule of Values Form shall be submitted to the place designated for receipt of Bids. Bid forms not followed by a properly completed Schedule of Values shall be considered incomplete and shall receive no further consideration. An incomplete Schedule of Values will not be accepted.
- N. The Undersigned has included all required Certificates of Insurance, etc.
- O. The Undersigned hereby affirms and states that the prices quoted herein constitute the total costs for the work involved in the respective items and that this cost also includes taxes, insurance, royalties, transportation charges, use of tools and equipment, superintendence, overhead, profits and other work, services and conditions necessarily involved in the work done and the materials furnished, in accordance with the requirements of the Contract.
- P. The BIDDER hereby states that he proposes, if awarded the Contract, to use the following subcontractors on this project: (List only one subcontractor for each item.)

Sub-Trade

Name

Grading:

Plumbing:

HVAC:

Electrical

- Q. The Bidder shall state on the line below, if a corporation, the name of state in which incorporated and the date of said corporation.

Signed this \_\_\_\_\_ day of \_\_\_\_\_, 2025.

\_\_\_\_\_  
(Contractor)

By: \_\_\_\_\_  
(Signature of individual, partner or officer signing the Bid)

Its: \_\_\_\_\_  
(Title)

(SEAL)

License Number: \_\_\_\_\_  
(Seal required if Bidder is a Corporation)

## SCHEDULE OF VALUES

(This Schedule of Values is part of the BID and shall be e-mailed to the office of the Architect at [lgetty@dp3architects.com](mailto:lgetty@dp3architects.com) and the Construction Manager Adam Failla at [adam@claytonconstruction.net](mailto:adam@claytonconstruction.net) within 24 hours after the Bid Date and Time. Note – if a Division is not required in the project scope indicate Not Applicable “NA” on the associated line.)

<i>Division</i>	<i>Category</i>	<i>Subtotal</i>
Zero	General Conditions	
One	Temporary Facilities	
	Cleaning	
Two	Sitework	
	Trenching, Backfilling & Compacting	
	Pavement & Marking	
Three & Four	Cast-In-Place Concrete & Masonry	
Five	Structural Steel & Misc. Metals	
Six	Carpentry (Rough & Finish)	
	Casework	
Seven	Thermal And Moisture Protection	
Eight	Doors, Frames & Hardware	
	Glass & Glazing	
Nine	Wall & Ceiling Systems	
	Flooring	
	Painting	
Ten	Specialties	
Eleven	Food Service Equipment	
Twelve	Furnishings	
Twenty-One	Fire Suppression Systems	
Twenty-Two	Plumbing	
Twenty-Three	HVAC Equipment & Ductwork	
Twenty-Six	Lighting, Panels, Switchgear & Conductors	
	Permits	
	Fees	
	Insurance	
	Bid Security	
	Performance & Payment Bond	
	Overhead / Profit	
	Tax (If Applicable)	
<b>PROJECT TOTAL</b>		



## INSURANCE REQUIREMENTS

The contractor shall procure and maintain, during the life of the contract, insurance coverage, for not less than any limits of liability shown between and shall include contractual liability insurance as applicable to the contractor's obligations, with a carrier authorized to do business in the State of South Carolina.

All coverage shall be primary and shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability. Original endorsements, signed by a person authorized to bind coverage on its behalf, shall be furnished to the Owner by the successful bidder.

### CERTIFICATES OF INSURANCE MUST BE INCLUDED IN THE BID.

- A. Commercial General Liability: The contractor shall maintain insurance for protection against all claims arising from injury to person or persons not in the employment of the contractor and against all claims resulting from damage to any property due to any act or omission of the contractor, his agents, or employees in the operation of the work or the execution of this contract.

Contractor shall maintain General Liability coverage required for a period of not less than five (5) years after project completion. General Liability must include Products/Completed Operations coverage.

Where the work to be performed involves excavation of other underground work or construction, the property damage insurance provided shall cover all claims due to destruction of subsurface property such as wire, conduits, pipes, etc. caused by the contractor's operation. The minimum shall be as follows:

Bodily Injury (Injury or Accidental Death) and Property Damage	\$1,000,000.00 General Liability \$2,000,000.00 Aggregate
---	--

- B. Comprehensive Automobile Liability: The contractor shall maintain Automobile Liability Insurance for protection against all claims arising from the use of vehicles, rented vehicles, or other vehicles in the prosecution of the work included in the contract. Such insurance shall cover the use of automobiles and trucks on and off the site of the project. The minimum amounts of Automobile Liability Insurance shall be as follows:

Bodily Injury (Injury or Accidental Death) and Property Damage	\$1,000,000.00 Combined Single Limit
---	--------------------------------------

- C. South Carolina Workers' Compensation Insurance: The contractor shall maintain Workers' Compensation Insurance for all of his/her employees who are in any way connected with the performance under this agreement. Such insurance shall comply with all applicable state laws.

South Carolina Workers' Compensation Employers Liability Insurance	Statutory Limits \$500,000.00 Each Accident \$500,000.00 Disease Each Employee \$500,000.00 Disease Policy Limit
---	---

Contractor shall provide the Agency with a Certificate of Insurance showing proof of insurance acceptable to the Agency. Certificates containing wording that releases the insurance company from liability of non-notification of cancellation of insurance policy are not acceptable.

Contractor and/or its insurers are responsible for payment of any liability arising out of Workers' Compensation, unemployment or employee benefits offered to its employees.

Insurance is to be placed with insurers with a current AM Best's rating of not less than A:VII, and licensed to operate in South Carolina by the South Carolina Department of Insurance, unless otherwise acceptable to the Agency.

Workers' Compensation policy is to be endorsed to include a waiver of subrogation in favor of the Agency, its officers, officials, employees and agents.

Deductibles, Co-Insurance Penalties & Self-Insured Retention: The contractor shall agree to be fully and solely responsible for any costs or expenses as a result of a coverage deductible, or insurance penalty, or self-insured retention; including any loss not covered because of the operation of such deductible, co-insurance penalty or self-insured retention.

Subcontractors' Insurance: The contractor shall agree to cause each subcontractor employed by the contractor to purchase and maintain insurance of the type specified herein, unless the contractor's insurance provides coverage on behalf of the subcontractor. When requested by the Agency, the contractor shall agree to obtain and furnish copies of certificates of insurance evidencing coverage by each subcontractor.

**BID BOND**

(A Bid Bond is part of the BID. Refer to Section 00 21 13 Instruction to Bidders, paragraph 3.14-B for acceptable formats.)

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned as Principal and

\_\_\_\_\_  
as Surety, are hereby held and firmly bound unto

\_\_\_\_\_  
NEWBERRY COUNTY as OWNER in the penal sum of

\_\_\_\_\_  
for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

Signed this \_\_\_\_\_ day of \_\_\_\_\_, 2025.

The conditions of the above obligation is such that whereas the Principal has submitted to NEWBERRY COUNTY certain BID, attached hereto and hereby made a part hereof to enter into a Contract in writing for the **NEWBERRY COUNTY - PROSPERITY PARK IMPROVEMENTS**.

NOW THEREFORE,

If said Bid shall be rejected, or in the alternate, If said Bid shall be accepted and the Principal shall execute and deliver a Contract in the Form of Agreement attached hereto (properly completed in accordance with said Bid) and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

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

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

In the Present of:

PRINCIPAL:

Witness: \_\_\_\_\_

By: \_\_\_\_\_

SURETY:

Witness: \_\_\_\_\_

By: \_\_\_\_\_

## PERFORMANCE AND PAYMENT BOND – PROOF OF COVERAGE

(A proof of ability to provide Performance and Payment Bonds is part of the BID. Refer to Section 00 21 13 Instructions To Bidders paragraph 3.15-C for acceptable formats.)

KNOW ALL MEN BY THESE PRESENTS: That we

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as Principal, also referred to as CONTRACTOR, and

---

as Surety, are held and firmly bound unto NEWBERRY COUNTY as Owner, in the full sum of

---

(\$ \_\_\_\_\_) Dollars, for the payment of which will and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, by these presents.

WHEREAS, the above bound principal has entered into a contract with the Owner dated \_\_\_\_\_ day of \_\_\_\_\_, 2025., for

---

NOW, THEREFORE, the conditions of this obligation are such that if the above bound Principal shall faithfully and fully comply with the terms and conditions of said contract, including, but not limited to any obligations created by way of warranties and/or guarantees for workmanship and materials which warranty and/or guarantee may extend for a period of time beyond completion of said contract, and such alterations or additions as may be made therein or in the plans and specifications, and shall indemnify and save the Owner harmless against all claims for damages by reason of any default or negligence, want of skill or care on the part of said principal or Agents in and about the performance of said contract, and shall comply with all laws pertaining to said work, and shall comply with and perform any and all warranties and/or guarantees provided for in said contract, then this obligation shall be void; otherwise of full force and effect.

PROVIDED, further that upon either the default of the Principal, or the failure of the said Principal to promptly and efficiently prosecute said work, in any respect, in accordance with the Contract Documents, the above bound Surety shall either remedy the default of the Principal or shall take charge of said work, and complete the Contract at his own expense, pursuant to its terms, receiving, however, any balance of funds in the hands of said Owner due under said contract.

It shall be the duty of the Surety to give an unequivocal notice in writing to the Owner within ten- (10) days after receipt of a declaration of default of the Surety's election either to remedy the default or defaults promptly, or to perform the contract promptly, time being of the essence. In said notice of election, the Surety shall indicate the date on which the remedy or performance will commence, and it shall then be the duty of the Surety to give prompt notice in writing to the Owner immediately upon completion of (a) the remedy and/or correction of each default, (b) the remedy and/or correction of each item of condemned work, (c) the furnishings of each omitted item of work, and (d) the performance of the contract. The Surety shall not assert solvency of its Principal as justification for its failure to give notice of election or for its failure to promptly remedy the default or defaults or perform the contract.

In the event said Principal shall fail or delay the prosecution and completion of said Work and said Surety shall also fail to act promptly as hereinabove provided, then the Owner shall cause ten- (10) days notice of such failure to be given, both to said Principal and Surety, and at the expiration of said ten- (10) days, if said Principal or Surety do not proceed promptly to execute said Contract, the Owner shall have the authority to cause said work to be done and when the same is completed and the cost thereof estimated, the said Principal and Surety shall and hereby agree, to pay any excess in the cost of said work above the agreed price to be paid under said Contract.

Upon completion of said Contract pursuant to its terms, if any funds remain due on said Contract, the same shall be paid to said Principal or Surety.

The said Principal and Surety further agree as part of this obligation to pay all such damages of any kind to person or property that may result from a failure in any respect to perform and complete said Contract including, but not limited to, all repair and replacement costs necessary to rectify purchase and installation error and fees.

The decision of the Owner, upon any disputed question connected with the execution of said Contract, or any failure or delay in the prosecution of the work by said Principal or Surety, shall be final and conclusive.

The Surety agrees that other than as is provided in this bond, it may not demand of the Owner that the Owner shall (a) perform anything or act, (b) give any notice, (c) furnish any clerical assistance, (d) render any service, (e) furnish any papers or documents, or (f) take any other action of any nature or description which is not required of the Owner to be done under the contract documents.

IN WITNESS WHEREOF, the Surety and Principal have executed this instrument under their several seals this

\_\_\_\_\_ day of \_\_\_\_\_, 2025.,  
the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

In the Present of:

PRINCIPAL:

Witness: \_\_\_\_\_

By: \_\_\_\_\_

SURETY:

Witness: \_\_\_\_\_

By: \_\_\_\_\_

NOTE:

- (a) Where the Performance Bond is executed by an attorney-in-fact, there shall be attached to each copy of the Bond, a certified copy of Power of Attorney properly executed and dated.
- (b) An authorized agent of the bonding company, licensed to do business in South Carolina shall countersign each copy of the Bond. The title of the person countersigning the Bond shall appear after his or her signature.
- (c) The Seal of the bonding company shall be attached to each copy of the Bond.
- (d) The CONTRACTOR'S signature on the Bond shall correspond with the signature in the Contract.
- (e) The Bond shall be accompanied by a corporate resolution (which may be combined with the corporate resolution granting the signing officer authority to execute contracts) granting the corporate officer whom executes the Bond, the authority to do so.
- (f) Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended), and be authorized to transact business in the State of South Carolina.

## BIDDER'S AFFIDAVIT

(This Affidavit is part of the BID)

STATE OF: \_\_\_\_\_

COUNTY OF: \_\_\_\_\_

Being duly sworn deposes and says that he resides at:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

That he is: \_\_\_\_\_

*(Give Name and Title)* who signed the above Proposal or BID, that he was duly authorized to sign and that the BID is the true offer of the BIDDER, that the seal attached is that seal of the BIDDER and that all the declarations and statements contained in the BID are true to the best of his knowledge and belief.

\_\_\_\_\_  
*(Affiant)*

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 2025.

\_\_\_\_\_  
*(Notary Public)*

My Commission expires: \_\_\_\_\_ day of \_\_\_\_\_, 202\_\_.

*(SEAL)*

**FORM OF NON-COLLUSION AFFIDAVIT**

(This Affidavit is part of the BID)

STATE OF: \_\_\_\_\_

COUNTY OF: \_\_\_\_\_

\_\_\_\_\_  
Being duly sworn deposes and says that he is

\_\_\_\_\_  
(Sole Owner, Partner, President, Secretary, Etc...) of

\_\_\_\_\_.

the party making the foregoing Proposal or BID that such BID is genuine and not collusive or sham; that said BIDDER has not colluded, conspired, connived, or agreed, directly or indirectly, with any BIDDER or person, to put in a sham BID, or that such other person shall refrain from bidding, and has not in any manner, directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the Bid Price of Affiant or any other BIDDER, or to fix any overhead, profit or cost element of said Bid Price, or of that of any other BIDDER, or to secure any advantage against OWNER any person interested in the proposed Contract; and that all statements in said Proposal or Bid are true; and further, that such BIDDER has not, directly or indirectly submitted this BID, or the contents thereof, or divulged information or data relative thereto to any association or to any member or agent thereof.

\_\_\_\_\_  
(Affiant)

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 2025.

\_\_\_\_\_  
(Notary Public)

My Commission expires: \_\_\_\_\_ day of \_\_\_\_\_, 202\_\_.

(SEAL)

**END OF SECTION**

**FORM OF NON-COLLUSION AFFIDAVIT**

(This Affidavit is part of the BID)

STATE OF: \_\_\_\_\_

COUNTY OF: \_\_\_\_\_

\_\_\_\_\_  
Being duly sworn deposes and says that he is

\_\_\_\_\_  
(Sole Owner, Partner, President, Secretary, Etc...) of

\_\_\_\_\_.

the party making the foregoing Proposal or BID that such BID is genuine and not collusive or sham; that said BIDDER has not colluded, conspired, connived, or agreed, directly or indirectly, with any BIDDER or person, to put in a sham BID, or that such other person shall refrain from bidding, and has not in any manner, directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the Bid Price of Affiant or any other BIDDER, or to fix any overhead, profit or cost element of said Bid Price, or of that of any other BIDDER, or to secure any advantage against OWNER any person interested in the proposed Contract; and that all statements in said Proposal or Bid are true; and further, that such BIDDER has not, directly or indirectly submitted this BID, or the contents thereof, or divulged information or data relative thereto to any association or to any member or agent thereof.

\_\_\_\_\_  
(Affiant)

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 2025.

\_\_\_\_\_  
(Notary Public)

My Commission expires: \_\_\_\_\_ day of \_\_\_\_\_, 202\_\_.

(SEAL)

**END OF SECTION**



**SECTION 00 52 00  
STANDARD FORM OF AGREEMENT**

**INSERT NEWBERRY COUNTY CONSTRUCTION AGREEMENT**

THIS DOCUMENT IN ITS ENTIRETY IS HEREBY DECLARED A PART OF THESE CONTRACT DOCUMENTS.

(Copies of this document may be obtained through Newberry County, Attn: Crystal Waldrop,  
1309 College Street, PO Box 156, Newberry, SC 29108; Phone: 803.321.2100)

**END OF SECTION**

**SECTION 00 53 00  
SUPPLEMENT TO AGREEMENT FORM**

- 1.01 The "Standard Form of Agreement between Owner and Contractor - Stipulated Sum," AIA Document No. A101, June 2017 Edition, is part of these specifications.
- 1.02 The completed Form of Agreement will include the following:
- A. Progress Payment
1. Based upon Applications for Payment submitted to the Architect by the Contractor, the Owner shall make the progress payments on account of the Contract Sum to the Contractor as provided in the Conditions of the Contract as follows:
  2. Thirty (30) days from receipt of certified requisition by the Architect, Ninety (90%) percent of the proportion of the Contract Sum properly allocable to labor, materials and equipment incorporated in the Work and Ninety (90%) percent of the portion of the Contract sum properly allocable to materials and equipment suitably stored at the site or at some other location agreed upon in writing by the parties, up to five (5) days prior to the date on which the Application for Payment is submitted, less the aggregate of previous payments in case: and upon Substantial Completion of the entire Work, a sum sufficient to increase the total payments to ninety-five (95) percent of the Contract Sum, less such retainage as the Architect shall determine for all incomplete work and unsettled claims.
- B. Final Payment
1. Final Payment, constituting the entire unpaid balance of the Contract Sum, shall be paid by the Owner to the contractor Forty-five (45) days after Substantial Completion of the Work unless otherwise stipulated in the Certificate of Substantial Completion, provided the work has then been completed, the Contract fully performed, and all closeout documents submitted to the Architect.

**END OF SECTION**

**SECTION 00 70 00  
GENERAL CONDITIONS**

**INSERT AIA DOCUMENT A201 HERE**

**General Conditions of the Contract for Construction  
2017 Edition**

THIS DOCUMENT IN ITS ENTIRETY, IS HEREBY DECLARED A PART OF THESE CONTRACT DOCUMENTS.

(Copies of this document may be procured locally through the American Institute of Architect  
or the Association of General Contractors)

**END OF SECTION**

**SECTION 01 10 00  
SUMMARY**

**PART 1 GENERAL**

**1.01 PROJECT**

- A. Project Name: Newberry County – Prosperity Park Improvements
- B. Owner's Name: Newberry County
- C. The Project includes improvements to four park sites as described below:
  - 1. North Main Park improvements include demolition of an existing structure, upgrades to two existing gravel parking lots including new concrete accessible parking spaces and sidewalks, and a new 1,900 SF amenity structure to house a concessions kitchen, multi-fixture restrooms, a field office, a storage room, and a covered picnic area.
  - 2. Town Center Park improvements include a new 580 SF amenity structure to house three accessible restrooms and a storage room; upgraded multipurpose field lighting, and light pedestals along walking trail.
  - 3. Langford Park improvements include a new 1,100 SF amenity structure to house three accessible restrooms, a storage room, and a covered picnic area; upgrades to an existing gravel parking lot including new concrete accessible parking spaces and sidewalks, and new chain link fence and gates around the existing basketball court.
  - 4. Town Square improvements include a new 450 SF manufactured open air steel structure, brick paver plaza, water feature, miscellaneous electrical upgrades, new park benches/swings, and new landscaping and irrigation.

The project is located in Prosperity, SC 29127. The four sites are as follows. North Main Park located at North Main and Shiloh Street, Town Center Park located at 250 School Drive, Langford Park located at 304 Langford Street, and Town Square located at Main Street and Grace Street.

**1.02 CONTRACT DESCRIPTION**

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 52 00 - Agreement.

**1.03 WORK BY OWNER**

- A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:
  - 1. Furnishings.

**1.04 OWNER OCCUPANCY**

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

**1.05 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to the immediate construction site as indicated on the civil drawings.
- B. Arrange use of site and premises to allow:
  - 1. Work by Others.
  - 2. Work by Owner.
- C. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.

- 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Time Restrictions:
  - 1. Limit conduct of especially noisy exterior work to the hours of 7:00 am to 5:30 pm.
- E. Utility Outages and Shutdown:
  - 1. Prevent accidental disruption of utility services to other facilities.

#### **1.06 SPECIFICATION SECTIONS APPLICABLE TO ALL CONTRACTS**

- A. Unless otherwise noted, all provisions of the sections listed below apply to all contracts. Specific items of work listed under individual contract descriptions constitute exceptions.
- B. Section 01 20 00 - Price and Payment Procedures.
- E. Section 01 30 00 - Administrative Requirements.
- F. Section 01 32 16 - Construction Progress Schedule.
- G. Section 01 40 00 - Quality Requirements.
- H. Section 01 42 00 - Reference Standards.
- I. Section 01 50 00 - Temporary Facilities and Controls.
- J. Section 01 60 00 - Product Requirements.
- K. Section 01 70 00 - Execution Requirements.
- L. Section 01 74 19 – Construction Waste Management and Disposal
- M. Section 01 78 00 - Closeout Procedures.
- N. Section 01 79 00 – Demonstration and Training

**END OF SECTION**

**SECTION 01 20 00  
PRICE AND PAYMENT PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Price and Contract Time.
- C. Change procedures.
- D. Procedures for preparation and submittal of application for final payment.

**1.02 RELATED REQUIREMENTS**

- A. Document 00 52 00 – Standard Form of Agreement: Contract Price, retainages, payment period, monetary values of unit prices.
- B. Document 00 72 00 - General Conditions: Additional requirements for progress payments, final payment, changes in the Work.
- C. Section 01 21 00 - Allowances: Payment procedures relating to allowances.

**1.03 SCHEDULE OF VALUES**

- A. Form to be used: AIA G703.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- F. Revise schedule to list approved Change Orders, with each Application For Payment.

**1.04 APPLICATIONS FOR PROGRESS PAYMENTS**

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Form to be used: AIA G702.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
  - 1. Item Number.
  - 2. Description of work.
  - 3. Scheduled Values.
  - 4. Previous Applications.
  - 5. Work in Place and Stored Materials under this Application.
  - 6. Authorized Change Orders.
  - 7. Total Completed and Stored to Date of Application.
  - 8. Percentage of Completion.
  - 9. Balance to Finish.

- 10. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Submit four copies of each Application for Payment.
- H. Include the following with the application:
  - 1. Transmittal letter as specified for Submittals in Section 01 30 00.
  - 2. Partial release of liens from major Subcontractors and vendors.
  - 3. Affidavits attesting to off-site stored products.
- I. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

#### **1.05 MODIFICATION PROCEDURES**

- A. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
  - 1. The document will describe the required changes and will designate method of determining any change in Contract Price or Contract Time.
  - 2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 calendar days.
- D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01600.
- E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
- F. Substantiation of Costs: Provide full information required for evaluation.
  - 1. Provide following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
  - 2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.
- G. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the

Contract Price.

- I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- J. Promptly enter changes in Project Record Documents.

**1.06 APPLICATION FOR FINAL PAYMENT**

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
  - 1. All closeout procedures specified in Section 01 70 00.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



## **SECTION 01 21 00 ALLOWANCES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Cash allowances.

#### **1.02 RELATED REQUIREMENTS**

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

#### **1.03 SUMMARY**

- A. Section includes administrative and procedural requirements governing allowances.
  - 1. Specific work and tasks are defined in the Contract Documents by allowances. Allowances have been established in lieu of specifying complex, system integration tasks as part of the project specifications. The Contractor shall coordinate, schedule and manage the work of the System Integrator (hereinafter referred to as Integrator) on this project.
- B. Types of allowances include the following:
  - 1. Unforeseen\Unknown Condition Allowances.
  - 4. Undefined Scope Allowance.

#### **1.03 CASH ALLOWANCES**

- A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts. Mark ups and fees shall not be allowed.
- B. Costs Included in Cash Allowances: Overhead, profit, and related costs for products and equipment ordered 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. Architect Responsibilities:
  - 1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
- D. Contractor Responsibilities:
  - 1. Assist Architect in selection of products, suppliers, and installers.
  - 2. Obtain proposals from suppliers and installers and offer recommendations.
  - 3. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
  - 4. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Use the allowances only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- F. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

#### **1.04 ADJUSTMENT OF ALLOWANCES**

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances

for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
  2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
  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 because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
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.

## **1.06 SUBMITTALS**

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Coordinate and process submittals for allowance items in same manner as for other portions of the Work. Integrator shall submit shop drawings and product data information to Architect for approval prior to ordering of any equipment.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

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

### **3.3 SCHEDULE OF ALLOWANCES**

Allowance No. 1: Prosperity Town Square (23235-D) Include the sum of \$2,000 for the large center stone and river rock mix at the base of the water feature.

**END OF SECTION**

**SECTION 01 23 00  
ALTERNATES**

**1.01 PROVISIONS INCLUDED**

- A. The conditions of the Contract and Division 1, General Requirements, apply to the work under this Section.

**1.02 DESCRIPTION OF WORK**

- A. Furnish all labor, materials and services necessary for the proper and complete execution of accepted alternates. The amount of alternate prices to be added to or deducted from the base bid shall be stated on the Bid Form and shall include the cost of any and all modifications made necessary by the Owner's acceptance of an alternate.
- B. State the amount to be added to or deducted from the base bid for each of the following alternates, if these alternates are added to the work of the Contract. The base bid shall not include the following listed alternates or work required to be performed in connection thereto.

**1.03 SCHEDULE OF ALTERNATES**

- A. Alternate No. 1: North Main Park (23235-A) – Provide light duty asphalt pavement at parking lots in lieu of gravel pavement.
  - 1. Base Bid Item: Upgrade existing gravel parking lots to meet gravel pavement section detail shown on Civil drawings.
  - 2. Alternative Item: In lieu of upgrading gravel pavement of existing parking lots, install light duty asphalt pavement per detail shown on Civil drawings.
- B. Alternate No. 2: Langford Park (23235-C) – Provide light duty asphalt pavement at parking lot in lieu of gravel pavement.
  - 1. Base Bid Item: Upgrade existing gravel parking lot to meet gravel pavement section detail shown on Civil drawings.
  - 2. Alternative Item: In lieu of upgrading gravel pavement of existing parking lot, install light duty asphalt pavement per detail shown on Civil drawings.
- C. Alternate No. 3: Town Square (23235-D) – Provide all site improvements in the Town Square document set.
  - 1. Base Bid Item: No scope.
  - 2. Alternative Item: Provide all site improvements in the Town Square document set.

**END OF SECTION**

**SECTION 01 30 00  
ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Preconstruction meeting.
- B. Progress meetings.
- C. Construction progress schedule.
- D. Coordination drawings.
- E. Field engineering.
- F. Submittals for review, information, and project closeout.
- G. Number of copies of submittals.
- H. Submittal procedures.
- I. E-mail Correspondence.

**1.02 RELATED REQUIREMENTS**

- A. Section 00 72 00 - General Conditions: Dates for applications for payment.
- B. Section 01 70 00 - Execution & Closeout Requirements: Additional coordination requirements.
- C. Section 01 78 00 - Closeout Submittals: Project record documents.

**1.03 PROJECT COORDINATION**

- A. Owner's Construction Manager: **Clayton Construction Company**.
- B. Cooperate with the Construction Manager in allocation of mobilization areas of site; for field offices and sheds, for construction access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Construction Manager.
- D. Comply with instructions of the Construction Manager for use of temporary utilities and construction facilities.
- E. Comply with the Construction Manager's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts. At a minimum, these shall include:
  - The General Contractor shall track and relay procedures, progress, coordination, sequence, and scheduling of the work to the CM for review monthly.
  - The General Contractor shall monitor costs as each project progresses and report any variances and deficiencies to the CM in a timely manner.
  - The General Contractor shall produce a monthly cash-flow report and forecast along with progress reports monthly to the CM.
  - The General Contractor shall conduct on-site meetings once a week with the CM to review progress, scheduling, clarification, and RFIs.
  - The General Contractor shall submit all RFIs, Submittals, Change Order Requests, and Pay applications to the CM for review and distribution.

- The General Contractor shall produce a daily report to include progress and staffing as well as a weekly report summary for CM and owner.
  - The General Contractor shall provide lien releases, Certificate of Substantial Completion, Consent of Surety, keys, manuals, and recorded drawings, and Warranty information upon completion with their retainage payment request.
- F. Coordinate field engineering and layout work under instructions of the Construction Manager.
- G. Make the following types of submittals to Architect through the Construction Manager:
1. Requests for interpretation.
  2. Requests for substitution.
  3. Shop drawings, product data, and samples.
  4. Test and inspection reports.
  5. Design data.
  6. Manufacturer's instructions and field reports.
  7. Applications for payment and change order requests.
  8. Progress schedules.
  9. Coordination drawings.
  10. Closeout submittals.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 PRECONSTRUCTION MEETING**

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
1. Owner.
  2. Construction Manager.
  2. Architect.
  3. Civil Engineer.
  4. Contractor.
- C. Agenda:
1. Execution of Owner-Contractor Agreement.
  2. Submission of executed bonds and insurance certificates.
  3. Distribution of Contract Documents.
  4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
  5. Designation of personnel representing the parties to Contract: Owner and General Contractor.
  6. Designation of personnel representing the parties to Contract: Architect and Engineers.
  7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  8. Scheduling.
  9. Scheduling activities of a Special Inspector.
- D. Record minutes and distribute copies within two days after meeting to participants including the Owner, Construction Manager, Architect, participants, and those affected by decisions made.

### **3.02 PROGRESS MEETINGS**

- A. Schedule and administer meetings throughout progress of the Work at maximum weekly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at

meetings.

- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Construction Manager, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of Work progress.
  - 3. Field observations, problems, and decisions.
  - 4. Identification of problems that impede, or will impede, planned progress.
  - 5. Review of submittals schedule and status of submittals.
  - 6. Review of off-site fabrication and delivery schedules.
  - 7. Maintenance of progress schedule.
  - 8. Corrective measures to regain projected schedules.
  - 9. Planned progress during succeeding work period.
  - 10. Coordination of projected progress.
  - 11. Maintenance of quality and work standards.
  - 12. Effect of proposed changes on progress schedule and coordination.
  - 13. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants.

### **3.03 CONSTRUCTION PROGRESS SCHEDULE**

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

### **3.04 COORDINATION DRAWINGS**

- A. Provide information required by the Construction Manager for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

### **3.05 FIELD ENGINEERING**

- A. Employ Land Surveyor licensed in State of Project location.
- B. Locate and protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- C. Control datum for survey is that indicated on Drawings.
- D. Submit copy of an as-built survey sealed and signed by Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.
- E. Maintain complete and accurate log of control and survey work as Work progresses.

- F. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- G. Promptly report to Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- H. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.

### **3.06 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  - 1. Product data.
  - 2. Shop drawings.
  - 3. Samples for selection.
  - 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 77 00 - CLOSEOUT PROCEDURES.

### **3.07 SUBMITTALS FOR INFORMATION**

- A. When the following are specified in individual sections, submit them for information:
  - 1. Design data.
  - 2. Certificates.
  - 3. Test reports.
  - 4. Inspection reports.
  - 5. Manufacturer's instructions.
  - 6. Manufacturer's field reports.
  - 7. Other types indicated.
- B. Submit for Architect's and Construction Manager's knowledge as contract administrator or for Owner. No action will be taken.

### **3.08 SUBMITTALS FOR PROJECT CLOSEOUT**

- A. When the following are specified in individual sections, submit them at project closeout:
  - 1. Project record documents.
  - 2. Operation and maintenance data.
  - 3. Warranties.
  - 4. Bonds.
  - 5. Other types as indicated.
- B. Submit for Owner's benefit during and after project completion.

### **3.09 NUMBER OF COPIES OF SUBMITTALS**

- A. Documents for Review:
  - 1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches (215 x 280 mm): Submit the number of copies that Contractor requires, plus two copies that will be retained by Architect.
  - 2. Larger Sheets, Not Larger Than 36 x 48 inches (910 x 1220 mm): Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by



Architect.

3. When appropriate, submittals may be issued electronically, in lieu of paper copies.
- B. Documents for Information: Submit two copies.
- C. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit two extra of submittals for information.
- D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
  1. After review, produce duplicates.
  2. Retained samples will not be returned to Contractor unless specifically so stated.

### **3.10 SUBMITTAL PROCEDURES**

- A. Transmit each submittal with AIA Form G810.
- B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- E. Deliver submittals to Architect at business address or via e-mail as noted in 3.08 Number of Copies of Submittals.
- F. Schedule submittals to expedite the Project, and coordinate submission of related items.
- G. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 10 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.
  5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
  6. Owner Review: All submittals will be reviewed by the Owner after completion of review by the Architect. Contractor must allow five working days for Owner review in addition to the Architect/Consultant review periods.
  7. The Architect will not return submittals to the Contractor prior to completion of Owner review.
  8. The Owner will review submittals concurrently with the Architect where required to expedite critical path submittals. Such concurrent reviews must be identified in

advance on the submittal schedule and approved by the Owner. The Contractor must submit a copy of the submittal directly to the Owner, in addition to the copies sent to the Architect.

9. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  10. Note date and content of previous submittal.
  11. Note date and content of revision in label or title block, and clearly indicate extent of revision.
  12. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- I. Provide space for Contractor and Architect review stamps.
- J. When revised for resubmission, identify all changes made since previous submission.
- K. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- L. Submittals not requested will not be recognized or processed.

### **3.11 E-MAIL CORRESPONDENCE**

- A. The subject line for all e-mail correspondence shall contain the following information:
1. Architect's project number.
  2. Abbreviated Project Name.
  3. Specification Section Number.
  4. Brief Description.

Example: 23235-A – Prosperity Parks-North Main Park - Spec Number - Description

### **END OF SECTION**

**SECTION 01 31 50**  
**COORDINATION DRAWINGS - REVISED**

**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 administrative provisions for coordinating construction operations on the Project including, but not limited to, the following:
  - 1. Coordination and Installation Drawings.
- B. Each contractor shall participate in coordination and installation requirements.
- D. Related Sections:
  - 1. Section 013100 "Project Management and Coordination" for general coordination procedures.
  - 2. Section 013200 "Construction Progress Documentation", for preparing and submitting Contractor's coordination drawings.
  - 3. Sections contained in Divisions 21, 22, 23, 26, 27, & 28, for MEP coordination.

**1.3 COORDINATION**

- A. Coordinate the development of the Coordination and Installation Drawings to ensure efficient, coordinated and orderly installation of each part of the Work.
  - 1. The Contractor shall include coordination and installation drawings in preparing a CPM schedule in accordance with Section 013200 – "Construction Progress Documentation".
  - 2. Phase coordination and installation drawings 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, i.e. below slab and above slab phases.
  - 3. Indicate adequate provisions to coordinate items scheduled for later installation.

**1.4 COMPOSITE COORDINATION AND INSTALLATION DRAWINGS**

- A. General: Prior to fabricating or installing work, the contractor shall prepare, submit and use composite installation and coordination drawings to assure proper coordination and installation of work. Installation or construction work shall not begin until the coordination drawings are completed, submitted, and approved.
  - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordinated composite drawings on standard printed data. Drawings shall include, but not be limited to, the following information, as applicable:
    - a. Underslab and Crawlspace Plans
    - b. Floor Plans and Reflected Ceiling Plans
    - c. Roof Plans

- d. Overhead Plenum Space
  - e. Mechanical Rooms
  - f. Structural and Slab Penetrations
2. Use applicable Drawings as a basis for preparation of coordinated composite drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
  3. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, plumbing, fire protection and electrical systems. Composite coordination drawings shall include new and existing elements, components, and systems.
  4. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended.
  5. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  6. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important to efficient flow of Work.
  7. Show location and size of access doors required for access to concealed dampers, valves, and other controls, including space required opening the access door.
  8. Consideration shall be made for scheduling, sequencing, movement, and positioning of large equipment into building during construction.
  9. Indicate penetrations in floors, walls, and ceilings and their relationship to assembly construction, other penetrations and installations. Identify where additional bracing and offsets are required to comply with Contract Documents.
  10. Indicate any required installation sequences to minimize cutting and patching.
  11. Indicate equipment and devices indicated on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals include manufacturer's literature showing internal wiring.
  12. Include dimensions on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to the Design Professional indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Organization: Organize drawings as follows:
1. Below Slab and Crawlspace Plans: Show structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical work.
  2. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  3. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical, plumbing, fire protection and electrical equipment, and related Work. Indicate subframing for support of ceiling and wall systems, mechanical, electrical, plumbing and fire protection components, and related work. Locate components within ceiling plenum to accommodate architectural ceiling height and layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
  4. Roof Plan: Show architectural and structural elements, and mechanical, plumbing, fire-protection, and electrical work.
  5. Mechanical Rooms: Showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment, piping and conduit.
  6. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

- C. Systems: Include, but do not necessarily limit to, the following:
1. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - c. Ductwork, grilles, registers, diffusers, dampers, access panels.,
    - d. Equipment connections, including MEP equipment, food service equipment and laboratory equipment.
    - e. Fire rated partitions and locations of fire, combination fire/smoke and smoke dampers.
    - f. Clearances, including maintenance, coil and filter removal, valve stem, insulation installation, etc.
    - g. Fire-rated enclosures around ductwork.
  2. Electrical and Specialty Systems Work: Show the following:
    - a. Runs of vertical and horizontal conduit 1-1/2 inch diameter and larger, and racks of smaller conduit.
    - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
    - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    - d. Location of pull boxes and junction boxes dimensioned from column center lines.
  3. Fire Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
  4. Framing
    - a. All king studs, headers, bracing, miscellaneous framing, and any items that may affect coordination with other disciplines.
- D. Preparation: Prepare coordination digital data files in accordance with the following requirements:
1. File Preparation Format: AutoCAD or REVIT. Reproduction of any portion of the contract drawings for re-submittal as a shop drawing is prohibited. Shop drawings produced in such a manner will be rejected and returned not reviewed. Installation and coordination drawings shall be to scale reflecting actual equipment sizes approved for the project.
  2. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    - b. Digital Data Software Program: Drawings are available in Revit.
    - c. Contractor shall execute data licensing agreement in the form of AIA Document C106, or in alternate Format acceptable to and generated by the Architect, Engineers, and Consultants.
  3. Meetings: Contractor coordination meetings shall be held continuously until the coordination drawings are complete and approved by all parties. Meetings shall be scheduled as required to complete the drawings in a timely manner as to not impact the project schedule. Additional time or compensation shall not be awarded based on the complexity or effort required to complete the coordination drawings.
  4. Conflicts: In the event of conflicts involving location and layout of work, unless otherwise directed the General Contractor shall use the following priority to resolve the conflict:
    - a. Structure and partitions shall have highest priority.
    - b. Equipment locations and access
    - c. Ceiling systems and recessed light fixtures.

- d. Gravity drainage lines.
  - e. Medium pressure ductwork and devices.
  - f. Large pipe mains, valves and devices.
  - g. Pneumatic tube and material conveying systems (where applicable)
  - h. Low pressure ductwork, diffusers, registers, grilles, dampers
  - i. Fire protection piping, devices and heads.
  - j. Small piping, tubing, electrical conduit and devices.
    - 1) Conduits installed in corridors shall be maintained at least 6"-9" above finished ceiling and similarly grouped and tightly spaced.
    - 2) The space utilized for conduit shall be selected to allow access to all devices which normally require adjustment, repair, resetting, etc..
  - k. Access panels.
5. Any conflicts or discrepancies discovered in the preparation of the drawings which cannot be resolved by the Contractor(s) shall be brought to the Architect's attention for resolution.

## **1.5 SUBMITTALS**

- A. Submit drawing files using Portable Data File (PDF) format. Include transmittal indicating that each specialty trade has signed-off on each submitted coordination drawing.
  - 1. Composite overlay drawing of each area with all trades shown.
  - 2. Individual trade drawing of each area, i.e. Reflected Ceiling Plan, HVAC Ductwork, HVAC Piping, Plumbing, Fire Protection, Electrical.
  - 3. Prominent Architectural Features which may impact the coordination of indicated systems, such as cloud ceilings, soffits, etc.
- B. Consultant shall review coordination and installation drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Consultant determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Consultant will so inform Contractor, who shall make changes as directed and resubmit.
- C. Review of coordination drawings shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with architectural, structural, mechanical, electrical and other work.
- D. Contractor is responsible for timely updates to the coordination drawings to indicate as-built conditions for their own work. Updates are required to include all changes regardless of the source or reason for the change, including changes initiated by the Owner or Architect.

## **1.6 INSTALLATION**

- A. Conflicts discovered after the created and submission of the coordination and installation drawings and during the installation of the Work will be the responsibility of the Contractor(s) to resolve with the approval of Architect. Costs for these resolutions shall be the responsibility of the Contractor.
- B. Work fabricated/installed prior to the completion of the coordination and installation drawings is performed at the Contractors own risk, and compensation of time/costs for corrections will not be awarded.

- C. Any work installed that is not in conformance with final approved coordination and installation drawings shall be required to be removed and relocated. Compensation of time/costs for corrections will not be awarded.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 01 32 16**  
**CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

**1.02 SUBMITTALS**

- A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. Within 10 days after joint review, submit complete schedule.
- C. Submit updated schedule with each Application for Payment.
- D. Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by Architect.

**1.03 SCHEDULE FORMAT**

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 PRELIMINARY SCHEDULE**

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

**3.02 CONTENT**

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify work of separate stages and other logically grouped activities.
- C. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- D. Indicate delivery dates for owner-furnished products.
- E. Provide legend for symbols and abbreviations used.

**3.03 BAR CHARTS**

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

**3.04 REVIEW AND EVALUATION OF SCHEDULE**

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

**3.05 UPDATING SCHEDULE**

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.



- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

### **3.06 DISTRIBUTION OF SCHEDULE**

- A. Distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Architect, Owner.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

**END OF SECTION**

**SECTION 01 40 00  
QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Mock-ups.
- B. Control of installation.
- C. Testing and inspection services.

**1.02 RELATED REQUIREMENTS**

- A. Section 00 72 00 - General Conditions: Inspections and approvals required by public authorities.
- B. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- C. Section 01 42 16 - Definitions.
- D. Section 01 42 50 - Reference Standards.
- E. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

**1.03 REFERENCE STANDARDS**

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008.
- B. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2009.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2009.
- D. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2008.
- E. ASTM E 329 - Standard Specification for Agencies Engaged Construction Inspection and/or Testing; 2009.

**1.04 SUBMITTALS**

- A. Testing Agency Qualifications:
  - 1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
- B. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.
    - i. Results of test/inspection.

- j. Conformance with Contract Documents.
  - k. When requested by Architect, provide interpretation of results.
- 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
  - 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- E. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
  - 1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
  - 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

#### **1.05 REFERENCES AND STANDARDS - See Section 01 42 50**

#### **1.06 TESTING AND INSPECTION AGENCIES**

- A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

### **PART 2 PRODUCTS - NOT USED**

### **PART 3 EXECUTION**

#### **3.01 CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

### **3.02 MOCK-UPS**

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining Work.
- D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

### **3.03 TESTING AND INSPECTION**

- A. Testing Agency Duties:
  - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 2. Perform specified sampling and testing of products in accordance with specified standards.
  - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
  - 5. Perform additional tests and inspections required by Architect.
  - 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Agency may not approve or accept any portion of the Work.
  - 3. Agency may not assume any duties of Contractor.
  - 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
  - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
  - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
  - 3. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.
  - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
  - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

### **3.04 DEFECT ASSESSMENT**

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will

direct an appropriate remedy or adjust payment.

**END OF SECTION**

**SECTION 01 42 16  
DEFINITIONS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Other definitions are included in individual specification sections.

**1.02 DEFINITIONS**

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. Provide: To furnish and install.
- F. Supply: Same as Furnish.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 42 50  
REFERENCE STANDARDS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements relating to referenced standards.

**1.02 QUALITY ASSURANCE**

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by the Contract Documents by mention or inference otherwise in any reference document.

**END OF SECTION**

**SECTION 01 45 33**  
**CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Code-required special inspections.
- B. Testing services incidental to special inspections.
- C. Submittals.
- D. Manufacturers' field services.
- E. Fabricators' field services.

**1.02 ABBREVIATIONS AND ACRONYMS**

- A. AHJ: Authority having jurisdiction.
- B. IAS: International Accreditation Service, Inc.
- C. NIST: National Institute of Standards and Technology.

**1.03 DEFINITIONS**

- A. Code or Building Code: ICC (IBC)-2018, Edition of the International Building Code and specifically, Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. Special Inspection:
  - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract Documents and the referenced standards.
  - 2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

**1.04 REFERENCE STANDARDS**

- A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2014a.
- B. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2015.
- C. ICC (IBC)-2021 - International Building Code; 2021.

**1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
  - 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
  - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.



### **1.06 SPECIAL INSPECTION AGENCY**

- A. Owner or Architect will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
- B. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.
- C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

### **1.07 TESTING AND INSPECTION AGENCIES**

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL**

- A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
  - 1. Continuous Special Inspection: Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  - 2. Periodic Special Inspection: Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
  - 3. Refer to the Statement of Special Inspections at the end of this section for a list of all required inspections and their required frequency.

### **3.02 TESTING AGENCY DUTIES AND RESPONSIBILITIES**

- A. Testing Agency Duties:
  - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 2. Perform specified sampling and testing of products in accordance with specified standards.
  - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
  - 5. Perform additional tests and inspections required by Architect.
  - 6. Attend preconstruction meetings and progress meetings.
  - 7. Submit reports of all tests or inspections specified.
- B. Limits on Testing or Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Agency may not approve or accept any portion of the work.
  - 3. Agency may not assume any duties of Contractor.
  - 4. Agency has no authority to stop the work.
- C. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.
- D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

### **3.03 CONTRACTOR DUTIES AND RESPONSIBILITIES**

- A. Contractor Responsibilities, General:

1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
3. Provide incidental labor and facilities:
  - a. To provide access to work to be tested or inspected.
  - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
  - c. To facilitate tests or inspections.
  - d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Retain special inspection records.

**END OF SECTION**

**SECTION 01 50 00  
TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Project identification sign.
- I. Field offices.

**1.02 TELECOMMUNICATIONS SERVICES**

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

**1.03 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

**1.04 BARRIERS**

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

**1.05 FENCING**

- A. Construction: Contractor's option.

**1.06 SECURITY**

- A. Provide security and facilities to protect Work, constructed facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

**1.07 VEHICULAR ACCESS AND PARKING**

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

**1.08 WASTE REMOVAL**

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

- B. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

#### **1.09 PROJECT IDENTIFICATION**

- A. Provide project identification sign of design and construction indicated on Drawings.
- B. Erect on site at location indicated.
- C. No other signs are allowed without Owner permission except those required by law.

#### **1.10 FIELD OFFICES**

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

#### **1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 60 00  
PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Procedures for Owner-supplied products.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 42 16 - Definitions.

**1.03 SUBMITTALS**

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

**PART 2 PRODUCTS**

**2.01 NEW PRODUCTS**

- A. Provide new products unless specifically required or permitted by the Contract Documents.

**2.02 PRODUCT OPTIONS**

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

## **2.03 MAINTENANCE MATERIALS**

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

## **PART 3 EXECUTION**

### **3.01 SUBSTITUTION PROCEDURES**

- A. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- D. A request for substitution constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
  - 2. Will provide the same warranty for the substitution as for the specified product.
  - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
  - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure:
  - 1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
  - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
  - 3. The Architect will notify Contractor in writing of decision to accept or reject request.

### **3.02 OWNER-SUPPLIED PRODUCTS**

- A. Owner's Responsibilities:
  - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
  - 2. Arrange and pay for product delivery to site.
  - 3. On delivery, inspect products jointly with Contractor.
  - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
  - 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
  - 1. Review Owner reviewed shop drawings, product data, and samples.
  - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
  - 3. Handle, store, install and finish products.
  - 4. Repair or replace items damaged after receipt.

### **3.03 TRANSPORTATION AND HANDLING**

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

### **3.04 STORAGE AND PROTECTION**

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Prevent contact with material that may cause corrosion, discoloration, or staining.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION**

**SECTION 01 70 00  
EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: No limitations on working in existing building; vacated facility; work sequence; identification of removed materials.
- B. Section 01 30 00 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- C. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.
- D. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.

**1.03 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.

**1.04 QUALIFICATIONS**

- A. For survey work, employ a land surveyor registered in Greenville, SC and acceptable to Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.



### **1.05 PROJECT CONDITIONS**

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- C. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

### **1.06 COORDINATION**

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

## **PART 2 PRODUCTS**

### **2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.02 PREPARATION**

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

### **3.03 PREINSTALLATION MEETINGS**

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

### **3.04 LAYING OUT THE WORK**

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

### **3.05 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.06 ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as shown.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- C. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on drawings.
  - 2. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  - 3. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
  - 1. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  - 2. Verify that abandoned services serve only abandoned facilities.
  - 3. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- E. Protect existing work to remain.
  - 1. Prevent movement of structure; provide shoring and bracing if necessary.
  - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  - 3. Repair adjacent construction and finishes damaged during removal work.
- F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
  - 1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
  - 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
  - 3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
- G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- H. Refinish existing surfaces as indicated:
  - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
  - 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

- I. Clean existing systems and equipment.
- J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- K. Do not begin new construction in alterations areas before demolition is complete.
- L. Comply with all other applicable requirements of this section.

### **3.07 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
  - 1. Complete the work.
  - 2. Fit products together to integrate with other work.
  - 3. Provide openings for penetration of mechanical, electrical, and other services.
  - 4. Match work that has been cut to adjacent work.
  - 5. Repair areas adjacent to cuts to required condition.
  - 6. Repair new work damaged by subsequent work.
  - 7. Remove samples of installed work for testing when requested.
  - 8. Remove and replace defective and non-conforming work.
- D. Execute cutting and patching including excavation and fill to complete the work, to uncover work in order to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit products together to integrate with other work.
- E. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- F. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- G. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- H. Restore work with new products in accordance with requirements of Contract Documents.
- I. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- J. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- K. Patching:
  - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  - 2. Match color, texture, and appearance.
  - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
- L. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- M. Make neat transitions. Patch work to match adjacent work in texture and appearance.

### **3.08 PROGRESS CLEANING**

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### **3.09 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

### **3.10 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.11 DEMONSTRATION AND INSTRUCTION**

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.

### **3.12 ADJUSTING**

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

### **3.13 FINAL CLEANING**

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

### **3.14 CLOSEOUT PROCEDURES**

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

**END OF SECTION**

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

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for salvaging, recycling and disposing of construction waste.

**1.2 RELATED SECTIONS**

- A. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS:

**1.3 DEFINITIONS**

- A. Asphalt Pavement, Brick, and Concrete (ABC) Rubble: Rubble that contains only weathered (cured) asphalt pavement, clay bricks and attached mortar normally used in construction, or concrete that may contain rebar. The rubble shall not be mixed with, or contaminated by, another waste or debris.
- B. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- C. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- D. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- E. Recycle: Diversion of demolition and construction waste from the landfill for reuse.
- F. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- G. Salvage for Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Salvage/Recycle Requirements: Salvage and recycle as much non-hazardous demolition and construction waste as possible including the following materials:
  - 1. Construction Waste:
    - a. Site-clearing waste.
    - b. Concrete and concrete reinforcing steel.

- c. Masonry and CMU.
- d. Lumber, wood sheet materials and wood trim.
- e. Metals.
- f. Roofing.
- g. Insulation.
- h. Carpet and pad.
- i. Gypsum board.
- j. Piping.
- k. Wire and cable
- l. Electrical conduit.
- m. Packaging: 100 percent of the following uncontaminated packaging materials: Paper, cardboard, boxes, plastic sheet and film, polystyrene packaging, wood crates, plastic pails.

## **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference: Conduct conference at Project site. Review methods and procedures related to waste management including, but not limited to, the following:
  - 1. Review requirements for documenting quantities of each type of waste and its disposition.
  - 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.
  - 5. Provide recycling education and recycling information to Contractor and subcontractor employees working on the project.
  - 6. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  - 7. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 PLAN IMPLEMENTATION**

- A. General: Provide containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
  - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
  - 2. Review plan procedures and locations established for salvage, recycling, and disposal.



3. Provide appropriate recycling signage for containers and workspaces.
- 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, recycled, reused, donated, and sold.
  2. Comply with project requirements for controlling dust and dirt, environmental protection, and noise control.

### **3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL**

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical. For waste which cannot be separated at Project site, co-mingle only with waste which is to be separated later at a recycling facility.
  1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin. 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 off Owner's property and transport to recycling receiver or processor.
- C. On-site crushing of asphalt pavement, brick, and concrete (ABC) rubble is not allowed. All ABC waste must be transported off-site to an asphalt batching plant or to an ABC crushing or recycling operation that has been sited and permitted for that purpose.

### **3.3 RECYCLING DEMOLITION WASTE**

- A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Deposit all debris in designated container to be transported to approved aggregate recycling facility to be crushed and screened for use as satisfactory soil for fill or sub-base.

### **3.4 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.
- C. Concrete: Deposit all debris in designated container to be transported to approved aggregate recycling facility to be crushed and screened for use as satisfactory soil for fill or sub-base.
  - D. Masonry: Deposit all masonry debris in designated container to be transported to approved aggregate recycling facility to be. Crushed and screened for use as satisfactory soil for general fill or satisfactory soil for fill or sub-base. Clean and stack undamaged whole masonry units on wood pallets for reuse.
  - E. Metals: Separate metals by material type if practical. Stack salvageable structural steel members according to size, type of member, and length.
  - F. Wood Materials:
    1. Clean Cut-Offs of Lumber: Deposit into designated clean wood container to be transported to designate recycling facility for use as mulch or bio-fuel.
    2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
  - G. Clean Gypsum Board: Deposit scraps of clean gypsum board into designated container protected from weather and transport to appropriate gypsum recycling facility to be processed into new gypsum board.

### **3.5 DISPOSAL OF WASTE**

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, 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.
  3. For solid waste disposal facilities, dispose of materials only in facilities which currently comply with applicable local regulations.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off the property and legally dispose of waste materials.

### **END OF SECTION**

**SECTION 01 78 00  
CLOSEOUT SUBMITTALS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

**1.02 RELATED REQUIREMENTS**

- A. Section 00 70 00 - General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

**1.03 SUBMITTALS**

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
  - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
  - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
  - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
  - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
  - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
  - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
  - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 PROJECT RECORD DOCUMENTS**

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed shop drawings, product data, and samples.

- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 2. Field changes of dimension and detail.
  - 3. Details not on original Contract drawings.

### **3.02 OPERATION AND MAINTENANCE DATA**

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

### **3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

### **3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. For Each Item of Equipment and Each System:
  - 1. Description of unit or system, and component parts.
  - 2. Identify function, normal operating characteristics, and limiting conditions.
  - 3. Include performance curves, with engineering data and tests.
  - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.

- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Include test and balancing reports.
- L. Additional Requirements: As specified in individual product specification sections.

### **3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS**

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- D. Prepare data in the form of an instructional manual.
- E. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- G. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- H. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- I. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- J. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- K. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- L. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- M. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
  - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
    - a. Significant design criteria.
    - b. List of equipment.
    - c. Parts list for each component.
    - d. Operating instructions.
    - e. Maintenance instructions for equipment and systems.
    - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Shop drawings and product data.

- N. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

### **3.06 WARRANTIES AND BONDS**

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

**END OF SECTION**

**SECTION 01 79 00  
DEMONSTRATION AND TRAINING**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
  - 1. All software-operated systems.
  - 2. HVAC systems and equipment.
  - 3. Plumbing equipment.
  - 4. Electrical systems and equipment.
  - 5. Landscape irrigation.
  - 6. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
  - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
  - 2. Finishes, including flooring, wall finishes, ceiling finishes.
  - 3. Items specified in individual product Sections.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 78 00 - Closeout Submittals: Operation and maintenance manuals.

**1.03 SUBMITTALS**

- A. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
  - 1. Submit to Architect for transmittal to Owner.
  - 2. Submit to Commissioning Authority for review and inclusion in overall training plan.
  - 3. Submit not less than two weeks prior to start of training.
  - 4. Provide an overall schedule showing all training sessions.
  - 5. Include at least the following for each training session:
    - a. Identification, date, time, and duration.
    - b. Description of products and/or systems to be covered.
    - c. Name of firm and person conducting training; include qualifications.
    - d. Intended audience, such as job description.
    - e. Objectives of training and suggested methods of ensuring adequate training.
    - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
- B. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
  - 1. Include applicable portion of O&M manuals.
  - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
  - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

**1.04 QUALITY ASSURANCE**

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
  - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
  - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 DEMONSTRATION - GENERAL**

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
  - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

### **3.02 TRAINING - GENERAL**

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- D. Provide training in minimum two hour segments.
- E. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- F. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- G. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
  - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
  - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
  - 3. Typical uses of the O&M manuals.
- H. Product- and System-Specific Training:
  - 1. Review the applicable O&M manuals.
  - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
  - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
  - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  - 6. Discuss common troubleshooting problems and solutions.
  - 7. Discuss any peculiarities of equipment installation or operation.



8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  10. Review spare parts and tools required to be furnished by Contractor.
  11. Review spare parts suppliers and sources and procurement procedures.
- I. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**END OF SECTION**

## **SECTION 02 41 00 DEMOLITION**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Selective demolition of building elements for alteration purposes.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 10 00 - Summary: Description of items to be removed by Owner.
- C. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- D. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- E. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- F. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

### **PART 2 PRODUCTS -- NOT USED**

### **PART 3 EXECUTION**

#### **3.01 SCOPE**

- A. Remove the portions of the building and within the site as indicated on the drawings.
- B. Remove paving and curbs as required to accomplish new work.
- C. Remove fences and gates.
- D. Remove other items indicated, for salvage and relocation.
- E. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as outlined in the drawings and specifications.

#### **3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS**

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1 Obtain required permits.
  - 2 Use of explosives is not permitted.
  - 3 Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  - 4 Provide, erect, and maintain temporary barriers and security devices.
  - 5 Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  - 6 Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 7 Do not close or obstruct roadways or sidewalks without permit.
  - 8 Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from

removal operations.

- 9 Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements that are not to be removed.
  - 1 Provide bracing and shoring.
  - 2 Prevent movement or settlement of adjacent structures.
  - 3 Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

### **3.03 EXISTING UTILITIES**

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

### **3.04 SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1 Verify that construction and utility arrangements are as shown.
  - 2 Report discrepancies to Architect before disturbing existing installation.
  - 3 Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
  - 1 Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.

- 1 Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
- 2 Remove items indicated on drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
  - 1 Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
  - 2 Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  - 3 See Section 01 10 00 for other limitations on outages and required notifications.
  - 4 Verify that abandoned services serve only abandoned facilities before removal.
  - 5 Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
  - 1 Prevent movement of structure; provide shoring and bracing if necessary.
  - 2 Perform cutting to accomplish removals neatly and as specified for cutting new work.
  - 3 Repair adjacent construction and finishes damaged during removal work.
  - 4 Patch as specified for patching new work.

### **3.05 DEBRIS AND WASTE REMOVAL**

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; in accordance with Section 01 74 19 Construction Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

### **END OF SECTION**

**SECTION 03 05 05  
UNDERSLAB VAPOR BARRIER**

**PART 1 GENERAL**

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Underslab and Crawl Space Vapor Barrier:
  - 1. Water Vapor Permeance: Not more than 0.010 perms, maximum.
  - 2. Thickness: 15 mils.
  - 3. Basis of Design:
    - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil): [www.stegoindustries.com](http://www.stegoindustries.com).
    - b. Or approved equal, per Section 01 60 00 Product Requirements.
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches.
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. Repair damaged vapor retarder before covering with other materials.
- G. Provide vapor barrier in the crawl space of the auditorium and lobby as indicated on the drawings. Tape all joints with manufacturer's approved tape. Secure sheet material to all exterior walls and all piers per manufacturer's instructions.

**END OF SECTION**

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

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section Includes Cast-in-Place Concrete for Following Items:
  - 1 Thrust blocks.
  - 2 Manholes.
  - 3 Fence post footing.

**1.02 SUBMITTALS**

- A. Product Data: Submit data on joint devices, attachment accessories, admixtures.
- B. Design Data:
  - 1 Submit concrete mix design for each concrete strength.
  - 2 Submit separate mix designs if admixtures are required for following:
    - a Hot and cold weather concrete Work.
    - b Air entrained concrete Work.
  - 3 Identify mix ingredients and proportions, including admixtures.
  - 4 Identify chloride content of admixtures and whether or not chlorides were added during manufacture.
- C. Manufacturer's Certificate: Products meet or exceed specified requirements.

**1.03 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

**1.04 QUALITY ASSURANCE**

- A. Perform Work according to ACI 301 and 318.
- B. Comply with ACI 305R when pouring concrete during hot weather.
- C. Comply with ACI 306.1 when pouring concrete during cold weather.
- D. Acquire cement and aggregate from one source for Work.
- E. Perform Work according to SCDOT standards.

**1.05 AMBIENT CONDITIONS**

- A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Concrete:
  - 1 Cement:
    - a Comply with ASTM C150, Type I - Normal.
    - b Type: Portland.
  - 2 Normal Weight Aggregates:
    - a Comply with ASTM C33.

- b Coarse Aggregate Maximum Size: 3/4 inches, according to ACI 318.
  - 3 Water:
    - a Comply with ACI 318.
    - b Potable.
- B. Admixtures:
  - 1 Air Entrainment: Comply with ASTM C260.
  - 2 Chemical:
    - a Comply with ASTM C494.
    - b Type A - Water Reducing.
  - 3 Fly Ash or Calcined Pozzolan: Comply with ASTM C618, Class F or C.
  - 4 Silica Fume: Comply with ASTM C1240.
  - 5 Slag:
    - a Description: Ground-granulated blast-furnace slag.
    - b Comply with ASTM C989.
    - c Grade 100.
  - 6 Plasticizing:
    - a Comply with ASTM C1017.
    - b Type I plasticizing, II plasticizing and retarding.
- C. Joint Devices and Filler:
  - 1 Joint Filler, Type A:
    - a Description: Asphalt-impregnated fiberboard or felt.
    - b Comply with ASTM D1751, D994.
    - c Thickness: 1/4 inch.
    - d Profile: Tongue-and-groove.
  - 2 Sealant:
    - a Comply with ASTM D6690, Type I.

## **2.02 CONCRETE MIX**

- A. Select proportions for normal weight concrete according to ACI 301, Method 1, 2, 3.
- B. Performance and Design Criteria:
  - 1 Compressive Strength: 3,000 psi or as noted on Drawings.
  - 2 Cement Type: ASTM C150.
  - 3 Aggregate Type: Normal weight.
  - 4 Maximum Water-Cement Ratio: 0.45 by weight
  - 5 Aggregate Size:
    - a Maximum: 3/4 inch
  - 6 Air Content: 3 to 6 percent, plus or minus 1.5 percent.
  - 7 Admixture Type: Air - Entraining
  - 8 Maximum Fly Ash or Pozzolan Content: 50 percent of cementitious materials by weight.
  - 9 Maximum Slag Content: 50 percent of cementitious materials by weight.
  - 10 Slump: 3 inches, plus or minus 1 inch.

- C. Admixtures:
  - 1 Include admixture types and quantities indicated in concrete mix designs only if approved by Engineer.
  - 2 Cold Weather:
    - a Use accelerating admixtures in cold weather.
    - b Use of admixtures will not relax cold-weather placement requirements.
  - 3 Hot Weather: Use set-retarding admixtures.
  - 4 Do not use calcium chloride or admixtures containing calcium chloride.
  - 5 Add air entrainment admixture to concrete mix for Work exposed to freezing and thawing or deicing chemicals.
  - 6 For concrete exposed to deicing chemicals, limit fly ash, pozzolans, silica fumes, and slag content as required by applicable code.
- D. Average Compressive Strength Reduction: Not permitted.
- E. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C94, C685.
- F. Site-Mixed Concrete: Mix concrete according to ACI 318.

### **2.03 ACCESSORIES**

- A. Bonding Agent:
  - 1 Description: Polymer resin emulsion, Polyvinyl acetate, Latex emulsion, Two- component modified epoxy resin, Non-solvent two-component polysulfide epoxy, Mineral-filled polysulfide polymer epoxy, Mineral-filled polysulfide polymer epoxy resin, Polyamide-cured epoxy.
- B. Non-shrink Grout:
  - 1 Description: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents.
  - 2 Comply with ASTM C1107.
  - 3 Minimum Compressive Strength: 2,400 psi in 48 hours and 7,000 psi in 28 days.
- C. Concrete Reinforcing Fibers:
  - 1 Description: High-strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete.
  - 2 Comply with ASTM C1116.
  - 3 Tensile Strength: 130 ksi.
  - 4 Toughness: 15 ksi.
  - 5 Fiber Length: 3/4 inch.
  - 6 Fiber Count: 34 million per lb.

## **PART 3 PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify requirements for concrete cover over reinforcement.
- B. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.



### **3.02 PREPARATION**

- A. Previously Placed Concrete:
  - 1 Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
  - 2 Remove laitance, coatings, and unsound materials.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

### **3.03 INSTALLATION**

- A. Placing Concrete:
  - 1 Place concrete according to ACI 301.
  - 2 Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
  - 3 Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
  - 4 Joint Filler:
    - a Separate slabs on grade from vertical surfaces with 1/4-inch-thick joint filler.
    - b Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
    - c Finish Joint Sealer Requirements: As specified by manufacturer.
  - 5 Deposit concrete at final position, preventing segregation of mix.
  - 6 Place concrete in continuous operation for each panel or section as determined by predetermined joints.
  - 7 Consolidate concrete.
  - 8 Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
  - 9 Place concrete continuously between predetermined expansion, control, and construction joints.
  - 10 Do not interrupt successive placement and do not permit cold joints to occur.
  - 11 Saw-Cut Joints:
    - a Saw-cut joints within 12 hours after placing.
    - b Cut into 1/4 depth of slab thickness.
- B. Curing and Protection:
  - 1 Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
  - 2 Maintain concrete with minimal moisture loss at relatively constant temperature for period as necessary for hydration of cement and hardening of concrete.
  - 3 Cure concrete according to ACI 308.1.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform inspection and testing according to ACI 318.
- B. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- D. Concrete Inspections:
  - 1 Continuous Placement Inspection: Inspect for proper installation procedures.
  - 2 Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- E. Strength Test Samples:
  - 1 Sampling Procedures: Comply with ASTM C172.
  - 2 Cylinder Molding and Curing Procedures:
  - 3 Comply with ASTM C31.
  - 4 Cylinder Specimens: Standard Field cured.
  - 5 Sample concrete and make one set of three cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
  - 6 If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
  - 7 Make one additional cylinder during cold weather concreting and field cure.
- F. Field Testing:
  - 1 Slump Test Method: Comply with ASTM C143.
  - 2 Air Content Test Method: Comply with ASTM C173, C231.
  - 3 Temperature Test Method: Comply with ASTM C1064.
  - 4 Compressive Strength Concrete:
    - a Measure slump and temperature for each sample.
    - b Measure air content in air-entrained concrete for each sample.
- G. Cylinder Compressive Strength Testing:
  - 1 Test Method: Comply with ASTM C39.
  - 2 Test Acceptance: According to ACI 318.
  - 3 Test one cylinder at 7 days.
  - 4 Test one cylinder at 28 days.
  - 5 Retain one cylinder for testing when requested by Engineer.
  - 6 Dispose of remaining cylinders if testing is not required.
- H. Core Compressive Strength Testing:
  - 1 Sampling and Testing Procedures: Comply with ASTM C42.
  - 2 Test Acceptance: According to ACI 318.
  - 3 Drill three cores for each failed strength test from failed concrete.
- I. Water-Soluble Chloride Ion Concentration Test Method:
  - 1 Comply with ASTM C1218.
  - 2 Test at 28 days.

- 3 Maximum Chloride Ion Concentration: As permitted by applicable code.
- J. Patching:
- 1 Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
  - 2 Honeycombing or Embedded Debris in Concrete:
    - a Not acceptable.
    - b Notify Engineer upon discovery.
  - 3 Patch imperfections as directed by Engineer, according to ACI 301, according to ACI 318.
- K. Defective Concrete:
- 1 Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
  - 2 Repair or replacement of defective concrete will be determined by Architect/Engineer.
  - 3 Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

**END OF SECTION**

**SECTION 04 05 11  
MORTAR AND MASONRY GROUT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Mortar for masonry.

**1.02 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Samples: Submit two samples of mortar, illustrating mortar color and color range.

**1.03 QUALITY ASSURANCE**

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.

**1.04 DELIVERY, STORAGE, AND HANDLING**

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

**1.05 FIELD CONDITIONS**

- A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

**PART 2 PRODUCTS**

**2.01 MORTAR AND GROUT APPLICATIONS**

- A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
- B. Integral Water-Repellent: All mortar and grout used in exterior faces shall be provided with integral water-repellent: polymeric water-repellent mortar admixtures. Provide in compliance with industry standards and per manufacturer's recommendations.
- C. Mortar Color: Natural gray unless otherwise indicated.
- D. Mortar Mix Designs: ASTM C270, Property Specification.
  - 1 Masonry below grade and in contact with earth: Type S.
  - 2 Exterior, Loadbearing Masonry: Type N.
  - 3 Exterior, Non-loadbearing Masonry: Type N.
  - 4 Exterior Repointing Mortar: Type N with maximum 2 percent ammonium stearate or calcium stearate per cement weight.
  - 5 Interior, Loadbearing Masonry: Type N.
  - 6 Interior, Non-loadbearing Masonry: Type O.
- E. Grout Mix Designs:
  - 1 Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
  - 2 Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.

## **2.02 MATERIALS**

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
  - 1 Color: Standard gray.
  - 2 Water repellant mortar for use with water repellant masonry units.
- B. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, hydrated lime, and graded sand; capable of producing Type O mortar in accordance with ASTM C270 with the addition of water only.
  - 1 Color: Standard gray.
- C. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
- D. Portland Cement: ASTM C150/C150M.
  - 1 Type: Type I - Normal.
  - 2 Color: Standard gray.
- E. Masonry Cement: ASTM C91.
  - 1 Type: Type N.
- F. Hydrated Lime: ASTM C207, Type S.
- G. Quicklime: ASTM C5, non-hydraulic type.
- H. Mortar Aggregate: ASTM C144.
- I. Grout Aggregate: ASTM C404.
- J. Water: Clean and potable.
- K. Bonding Agent: Latex type.

## **2.03 MORTAR MIXING**

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, re-temper only within two hours of mixing.

## **2.04 GROUT MIXING**

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

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Apply bonding agent to existing concrete surfaces.
- B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

### **3.02 INSTALLATION**

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.

**3.03 GROUTING**

A. Refer to structural drawings and specifications.

**3.04 FIELD QUALITY CONTROL**

A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 40 00 - Quality Requirements.

**3.05 SCHEDULES**

A. Refer to structural drawings and specifications for mortar type..

**END OF SECTION**

**SECTION 04 20 00  
UNIT MASONRY**

**PART 1 PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete Block.
- B. Mortar and Grout.
- C. Reinforcement and Anchorage.
- D. Flashings.
- E. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 72 00 – Manufactured Masonry
- B. Section 07 92 00 – Joint Sealers: Backing rod and sealant at control and expansion joints.

**1.03 REFERENCE STANDARDS**

- A. ASTM A82/A82M - Standard Specification for Steel Wire for Concrete Reinforcement; 2007.
- B. ASTM A641/A641M - Standard Specification for Zinc-Coated Carbon Steel Wire; 2009a.
- C. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2012.
- D. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- E. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2011.
- F. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- G. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2012.
- H. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- I. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2008).
- J. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2011a.
- K. ASTM C1357 - Standard Test Methods for Evaluating Masonry Bond Strength; 2009.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

**1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- D. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

## **PART 2 PRODUCTS**

### **2.01 CONCRETE MASONRY UNITS**

- A. Manufacturers:
  - 1 Cemex or approved equal.
- B. Concrete Block: Comply with referenced standards and as follows:
  - 1 Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depths, provided in the shapes, style and types as indicated on the drawings for specific locations.
  - 2 Special Shapes: Provide manufactured blocks configured for corners to match the face block shape, type and style.
  - 3 Load-Bearing Units: ASTM C90, normal weight.
    - a Hollow block, as indicated.
    - b Exposed faces: as noted on the drawings.
  - 4 Non-Loadbearing Units: ASTM C129.
    - a Hollow block, as indicated.
    - b Shape, style and type as noted on the drawings.
    - c Lightweight.
  - 5 Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2100 psi.
  - 6 All units shall be free of organic impurities that will cause rusting, staining or pop outs, and shall contain no combustible matter. The use of coal cinder aggregate/bottom ash, or similar waste products will not be allowed.
  - 7 The producer of the lightweight concrete masonry units shall furnish a letter of certification stating that all lightweight aggregate used in the manufacture of the units was expandable shale, clay, or slate produced by the rotary kiln process and shall be graded to assure constant texture, conforming to ASTM C331 and ASTM C330.
  - 8 All exterior units manufactured with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
    - a Performance of Units with Integral Water Repellent:
      - i Water Permeance: When tested per ASTM E514 and for a minimum of 72 hours.
        - No water visible on back of wall above flashing at the end of 24 hours.
        - No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
        - No more than 25% of wall area above flashing visibly damp at end of test.
      - ii Flexural Bond Strength: ASTM C1357; minimum 10% increase.
      - iii Compressive Strength: ASTM C1314; maximum 5% decrease.
      - iv Drying Shrinkage: ASTM C1148; maximum 5% increase in shrinkage.
    - b Use only in combination with mortar and grout that also has integral water repellent admixture.
    - c Use water repellent admixtures for masonry units, mortar and grout by a single manufacturer.



## **2.02 MORTAR AND GROUT MATERIALS**

- A. Masonry Cement: ASTM C91, Type N.
  - 1 Colored mortar: Premixed cement.
  - 2 Acceptable product: CEMEX Color Matched Mortar - Colors as indicated on the drawings.
  - 3 Substitutions: Approved equal. See Section 01 60 00 - Product Requirements.
- B. Portland Cement: ASTM C150, Type I; color as required to produce approved color sample.
  - 1 Not more than 0.60 percent alkali.
- C. Water: Clean and potable.
- D. Integral Water Repellent Admixture for Mortar and Grout: Polymeric liquid admixture added to mortar and grout at the time of manufacture.
  - 1 Use only in combination with masonry units manufactured with integral water repellent admixture.
  - 2 Use only water repellent admixture for mortar and grout from the same manufacturer as water repellent admixture in masonry units.
  - 3 Meet or exceed performance specified for water repellent admixture used in masonry units.

## **2.03 REINFORCEMENT AND ANCHORAGE**

- A. Manufacturers of Joint Reinforcement and Anchors:
  - 1 Substitutions: See Section 01 60 00 - Product Requirements.
- B. Single Wythe Joint Reinforcement: Truss type; ASTM A 82/A 82M steel wire, mill galvanized to ASTM A 641/A 641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

## **2.04 FLASHINGS**

- A. Metal Flashing Materials: Galvanized Steel, as specified in Section [07 62 00].
- B. Rubberized Asphalt Flashing: Self-adhering polymer-modified asphalt sheet; 0.025 inch total thickness; with cross-linked polyethylene top and bottom surfaces.

## **2.05 ACCESSORIES**

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Manufacturers:
  - 1 Substitutions: See Section 01 60 00 - Product Requirements.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## **2.06 MORTAR AND GROUT MIXES**

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  - 1 Exterior, loadbearing masonry: Type N.
- B. Grout: ASTM C476. Consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 PREPARATION**

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

### **3.03 COLD AND HOT WEATHER REQUIREMENTS**

- A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

### **3.04 COURSING**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1 Bond: Running.
  - 2 Coursing: One unit and one mortar joint to equal 8 inches.
  - 3 Mortar Joints: Concave.

### **3.05 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- J. Isolate masonry partitions from vertical structural framing members with a control joint.
- K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### **3.06 REINFORCEMENT AND ANCHORAGE - GENERAL**

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.

### **3.07 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY**

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.

### **3.08 CONTROL AND EXPANSION JOINTS**

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

### **3.09 TOLERANCES**

- A. Maximum Variation from Alignment of walls: 1/4 inch.
- B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

### **3.10 CUTTING AND FITTING**

- A. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### **3.11 CLEANING**

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.

### **3.12 PROTECTION**

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

## **END OF SECTION**

**SECTION 04 26 13  
MASONRY VENEER**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Brick.
  - 2. Mortar materials.
  - 3. Ties and anchors.
  - 4. Embedded flashing.
  - 5. Accessories.
  - 6. Mortar mixes.
- B. Products Installed but not Furnished under This Section:
  - 1. Cast-stone trim in masonry veneer.
  - 2. Steel lintels in masonry veneer.
- C. Related Requirements:
  - 1. Section 014339 "Mockups" for integrated exterior mockup requirements.
  - 2. Section 055000 "Metal Fabrications" for furnishing steel lintels for brick masonry.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type and color of the following:
  - 1. Clay face brick, in the form of straps of five or more bricks.
  - 2. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For each type and size of the following:
  - 1. Masonry units.
    - a. For exposed brick, include test report for efflorescence according to ASTM C 67.
  - 2. Cementitious materials. Include name of manufacturer, brand name, and type.
  - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

- B. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## **1.5 FIELD CONDITIONS**

- A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Obtain exposed masonry units, cementitious mortar components, and mortar aggregate from single source producer or manufacturer.
- B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

### **2.2 UNIT MASONRY, GENERAL**

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by

requirements in the Contract Documents.

- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.

## **2.3 BRICK**

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: Facing brick complying with ASTM C 216.
  - 1. Grade: SW.
  - 2. Type: FBS.
  - 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C 67.
  - 4. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
  - 5. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
  - 6. Application: Use where brick is exposed unless otherwise indicated.
  - 7. Color and Texture: As indicated on the drawings.

## **2.4 MORTAR MATERIALS**

- A. Mortar Cement: ASTM C 1329/C 1329M.
- B. Colored Cement Products: Packaged blend made from mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
  - 1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
  - 2. Pigments shall not exceed 5 percent of mortar cement by weight.
- C. Aggregate for Mortar: ASTM C 144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
- D. Water: Potable.

## 2.5 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
  - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
- C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Connector Section: Channel tabs for inserting into channel slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
  - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire.
- D. Adjustable Masonry-Veneer Anchors:
  - 1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
  - 2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- thick steel sheet, galvanized after fabrication.
  - 3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.
  - 4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and base for inserting wire tie. Self-adhering, modified bituminous gasket fits behind anchor plate and extends beyond pronged legs.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Hohmann & Barnard, Inc; DW-10-X.
      - 2) Wire-Bond; 1004X, Type III X.
  - 5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in sheathing.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Heckmann Building Products, Inc.; Pos-I-Tie.
      - 2) Hohmann & Barnard, Inc; Thermal 2-Seal Anchor.
      - 3) Wire-Bond; SureTie.
  - 6. Stainless-Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex

washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless-steel shank.

## **2.6 EMBEDDED FLASHING**

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
  2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  3. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
- B. Flexible Flashing: Use one of the following, at Contractor's option, unless otherwise indicated:
1. Stainless-Steel Laminated Flashing: Type 304 stainless steel core with polymer fabric laminated to one stainless steel face with non-asphalt adhesive.
    - a. Products: Subject to compliance with requirements, provide the following:
      - 1) York Manufacturing, Inc; Multi-Flash SS.
    - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
  2. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Advanced Building Products Inc.; Copper Fabric Flashing.
      - 2) Hohmann & Barnard, Inc; Copper Fabric Flashing.
      - 3) York Manufacturing, Inc; Multi-Flash 500.
  3. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) DuPont; Thru-Wall Flashing.
      - 2) Hohmann & Barnard, Inc; Flex-Flash.
      - 3) Hyload, Inc.; Hyload Cloaked Flashing System.
      - 4) Mortar Net Solutions; Total Flash.
    - b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of adhesive.
    - c. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.



- 1) Color: Gray.
- d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- C. Application: Unless otherwise indicated, use the following:
  1. Where flashing is indicated to receive counterflashing, use metal flashing.
  2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
  4. Where flashing is fully concealed, use flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings:
  1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- F. Termination Bars for Flexible Flashing: Stainless steel bars, 1 by 1/8 inch thick, with sealant trays, predrilled at 8-inch centers and stainless steel screw anchors.

## 2.7 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Weep/Vent Products: Use the following unless otherwise indicated:
  1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
- C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  1. Mortar Deflector: Strips, 1 inch and 10 inches high, with dovetail-shaped notches that prevent clogging with mortar droppings.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Advanced Building Products Inc.; Mortar Break.
      - 2) Hohmann & Barnard, Inc; Mortar Trap.
      - 3) Mortar Net Solutions; Mortar Net with Insect Barrier.
      - 4) York Manufacturing, Inc; Weep-Net.
- D. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing

mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Products: Subject to compliance with requirements, provide the following:
  - a. EaCo Chem, Inc.; NMD 80 New Masonry Detergent.
2. Note: Chemical applicator must be trained and use equipment approved by chemical manufacturer.

## **2.8 MORTAR MIXES**

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  1. Do not use calcium chloride in mortar or grout.
  2. Use mortar cement mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Use Type N unless another type is indicated.
- D. Pigmented Mortar: Use colored cement product.
  1. Pigments shall not exceed 5 percent of mortar cement by weight.
  2. Mix to match Architect's sample.
  3. Application: Use pigmented mortar for exposed mortar joints.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

### **3.2 TOLERANCES**

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

### **3.4 MORTAR BEDDING AND JOINTING**

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

### **3.5 ANCHORED MASONRY VENEERS**

- A. Anchor masonry veneers to wall framing and concrete backup with masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached anchors through sheathing to wall framing and concrete backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  - 2. Embed tie sections in masonry joints.
  - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  - 4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.
  - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

### **3.6 EXPANSION JOINTS**

- A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints as follows:
  - 1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."
- C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
  - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### **3.7 LINTELS**

- A. Install steel lintels where indicated.

- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.
- C. Provide silicone sealant between toe of lintel and face of brick to match mortar color.

### **3.8 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS**

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches. Mechanically fasten top of flashing securely by a termination bar with fasteners at 8 inches on center.
  - 3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
- C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
  - 1. Use specified weep/vent products to form weep holes.
  - 2. Space weep holes 24 inches o.c. unless otherwise indicated.
- D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.
- E. Install vents in head joints in exterior wythes immediately below shelf angles and at spacing indicated. Use specified weep/vent products to form vents.

### **3.9 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

### **3.10 REPAIRING, POINTING, AND CLEANING**

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 4. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### **3.11 MASONRY WASTE DISPOSAL**

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches in each dimension.
  - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste.
  - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

### **END OF SECTION**

**SECTION 05 52 13  
PIPE AND TUBE RAILINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Balcony railings and guardrails.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 20 00 - Unit Masonry: Placement of anchors in masonry.
- B. Section 09 91 13 - Painting and Coating: Paint finish.

**1.03 REFERENCE STANDARDS**

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.
- D. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

**PART 2 PRODUCTS**

**2.01 RAILINGS - GENERAL REQUIREMENTS**

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
- B. Design railing assembly, wall rails, and attachments to resist lateral force of 75 lbs at any point without damage or permanent set. Test in accordance with ASTM E 935.
- C. Allow for expansion and contraction of members and building movement without damage to connections or members.
- D. Dimensions: See drawings for configurations and heights.
  - 1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
  - 2. Intermediate Rails: 1-1/2 inches diameter, round.
  - 3. Posts: 1-1/2 inches diameter, round.
  - 4. Balusters: 1/2 inch square solid bar.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
  - 1. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.

**2.02 STEEL RAILING SYSTEM**

- A. Steel Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- C. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
- D. Galvanizing: In accordance with requirements of ASTM A123/A123M.

**2.03 FABRICATION**

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.

- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Welded Joints:
  - 1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
  - 2. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

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

#### **3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.
- C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.
- D. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

**END OF SECTION**



**SECTION 06 10 00  
ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Non-structural dimension lumber framing.
- B. Rough opening framing for doors, windows, and roof openings.
- C. Sheathing.
- D. Roof-mounted curbs.
- E. Roofing nailers.
- F. Roofing cant strips.
- G. Preservative treated wood materials.
- H. Fire retardant treated wood materials.
- I. Miscellaneous framing and sheathing.
- J. Communications and electrical room mounting boards.
- K. Concealed wood blocking, nailers, and supports.
- L. Miscellaneous wood nailers, furring, and grounds.

**1.02 RELATED REQUIREMENTS**

- A. Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing, refer to Structural Drawings.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.

**1.03 DELIVERY, STORAGE, AND HANDLING**

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

**PART 2 PRODUCTS**

**2.01 GENERAL REQUIREMENTS**

- A. Lumber fabricated from old growth timber is not permitted.

**2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS**

- A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).
- B. Sizes: Nominal sizes as indicated on drawings.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Standard or No. 3.

**2.03 CONSTRUCTION PANELS**

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- B. Other Applications:
  - 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
  - 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
  - 3. Other Locations: PS 1, C-D Plugged or better.

## **2.04 ACCESSORIES**

- A. Fasteners and Anchors:
  - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
  - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
  - 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Sill Flashing: As specified in Section 07 62 00.

## **2.05 FACTORY WOOD TREATMENT**

- A. Treated Lumber and Plywood: Comply with requirements of AWP A U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
  - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
  - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWP A standards.
- B. Fire Retardant Treatment:
  - 1. Manufacturers:
    - a. Arch Wood Protection, Inc: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
    - b. Hoover Treated Wood Products, Inc: [www.frtw.com](http://www.frtw.com).
    - c. Osmose, Inc: [www.osmose.com](http://www.osmose.com).
- C. Preservative Treatment:
  - 1. Manufacturers:
    - a. Arch Wood Protection, Inc: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
    - b. Chemical Specialties, Inc: [www.treatedwood.com](http://www.treatedwood.com).
    - c. Osmose, Inc: [www.osmose.com](http://www.osmose.com).
  - 2. Preservative Pressure Treatment of Lumber Above Grade: AWP A U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft (4.0 kg/cu m) retention.
    - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
    - b. Treat lumber exposed to weather.
    - c. Treat lumber in contact with roofing, flashing, or waterproofing.
    - d. Treat lumber in contact with masonry or concrete.
    - e. Treat lumber less than 18 inches (450 mm) above grade.
    - f. Treat lumber in other locations as indicated.

3. Preservative Pressure Treatment of Plywood Above Grade: AWP U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft (4.0 kg/cu m) retention.
  - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
  - b. Treat plywood in contact with roofing, flashing, or waterproofing.
  - c. Treat plywood in contact with masonry or concrete.
  - d. Treat plywood less than 18 inches (450 mm) above grade.
  - e. Treat plywood in other locations as indicated.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION - GENERAL**

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

### **3.02 BLOCKING, NAILERS, AND SUPPORTS**

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Specifically, provide the following non-structural framing and blocking:
  1. Cabinets and shelf supports.
  2. Wall brackets.
  3. Grab bars.
  4. Towel and bath accessories.
  5. Wall-mounted door stops.

### **3.03 ROOF-RELATED CARPENTRY**

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

### **3.04 INSTALLATION OF CONSTRUCTION PANELS**

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
  1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
  2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
  3. Install adjacent boards without gaps.
  4. Size and Location: As indicated on drawings.

### **3.05 CLEANING**

- A. Waste Disposal: Comply with the requirements of Section 01732.
  - 1. Comply with applicable regulations.
  - 2. Do not burn scrap on project site.
  - 3. Do not burn scraps that have been pressure treated.
  - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION**

**SECTION 06 16 00  
SHEATHING**

**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. Wall sheathing.
  2. Parapet sheathing.
  3. Sheathing joint and penetration treatment.
- B. Related Requirements:
1. Section 06 10 00 "Rough Carpentry" for plywood backing panels.
  2. Section 07 25 00 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

**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 plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
  2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
  3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
  4. For products receiving 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 plywood.
  2. Fire-retardant-treated plywood.
  3. Foam-plastic sheathing.

**1.5 QUALITY CONTROL**

- 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.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

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

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

### **2.2 WOOD PANEL PRODUCTS**

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

### **2.3 PRESERVATIVE-TREATED PLYWOOD**

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category 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. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

## **2.4 WALL SHEATHING**

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Georgia-Pacific Gypsum LLC.
    - b. National Gypsum Company.
    - c. USG Corporation.
  - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
  - 3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.
- B. Extruded-Polystyrene-Foam Sheathing: ASTM C 578, Type IV, in manufacturer's standard lengths and widths with tongue-and-groove or shiplap long edges as standard with manufacturer.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Dow Chemical Company (The).
    - b. Kingspan Insulation Limited.
    - c. Owens Corning.
  - 2. Thickness: 3/4 inch (19 mm).
  - 3. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

## **2.5 PARAPET SHEATHING**

- A. Plywood Sheathing: DOC PS 1 sheathing.
  - 1. Span Rating: Not less than 16/0.
  - 2. Nominal Thickness: Not less than 1/2 inch (13 mm).
- B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I sheathing.
  - 1. Span Rating: Not less than 16/0.
  - 2. Nominal Thickness: Not less than 7/16 inch (11.1 mm).
- C. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Georgia-Pacific Gypsum LLC.
    - b. National Gypsum Company.
    - c. USG Corporation.
  - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.

3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

## **2.6 FASTENERS**

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
  1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
  2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.
- G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

## **2.7 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS**

- A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 07 92 00 "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.



- C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in 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.
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. 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 parapet 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. Wall Sheathing:
    - a. Screw to cold-formed metal framing.
    - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

### **3.3 GYPSUM SHEATHING INSTALLATION**

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
  - 3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
  - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
  - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
  - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

### **3.4 FOAM-PLASTIC SHEATHING INSTALLATION**

- A. Comply with manufacturer's written instructions.
- B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.
- C. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

### **END OF SECTION**

**SECTION 06 20 00  
FINISH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Finish carpentry items.
- B. Wood casings and moldings.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 41 00 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- C. Section 09 91 23 - Painting and Coating: Painting and finishing of finish carpentry items.

**1.04 REFERENCE STANDARDS**

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2004.
- B. ANSI A208.1 - American National Standard for Particleboard; 2009.
- C. AWI (QCP) - Quality Certification Program, [www.awiqcp.org](http://www.awiqcp.org); current edition at [www.awiqcp.org](http://www.awiqcp.org).
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.

**1.05 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with installation of associated and adjacent components.

**1.06 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
  - 1. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot.
  - 2. Provide the information required by AWI/AWMAC/WI Architectural Woodwork Standards.
  - 3. Include certification program label.

**1.07 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
  - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification: Provide AWI Quality Certification Program inspection report and quality certification of completed work.
  - 1. Provide labels or certificates indicating that the work complies with requirements of AWS Grade or Grades specified.
  - 2. Prior to delivery to the site provide shop drawings with certification labels.
  - 3. Provide labels on each product when required by certification program.
  - 4. Upon completion of installation provide certificate certifying that the installation and products meet the specified requirements.
  - 5. Arrange and pay for inspections required for certification.
  - 6. Replace, repair, or rework all work for which certification is refused.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Protect work from moisture damage.

## **PART 2 PRODUCTS**

### **2.01 FINISH CARPENTRY ITEMS**

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Premium Grade.
- B. Interior Woodwork Items:
  - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.
  - 2. Window Sills: Clear fir; prepare for paint finish.

### **2.02 WOOD-BASED COMPONENTS**

- A. Wood fabricated from old growth timber is not permitted.

### **2.03 ACCESSORIES**

- A. Lumber for Shimming and Blocking
- B. Wood Filler: Solvent base, tinted to match surface finish color.

### **2.04 FABRICATION**

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.

### **3.02 INSTALLATION**

- A. Install work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

### **3.03 PREPARATION FOR SITE FINISHING**

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 90 00.

### **3.04 TOLERANCES**

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

**END OF SECTION**

**SECTION 07 21 00  
THERMAL INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Concealed building insulation.
  - 2. Vapor retarders.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
  - 1. Division 22 - PLUMBING for plumbing insulation.
  - 2. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for mechanical insulation.

**1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. Manufacturer's product data indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.
  - 2. Manufacturer's product data indicating no urea-formaldehyde content.

**1.3 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Surface-Burning Characteristics: ASTM E 84.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration by 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 plastic insulation as follows:
  - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### **2.1 GLASS-FIBER BLANKET INSULATION**

- A. Available Manufacturers:
  1. CertainTeed Corporation.
  2. Guardian Fiberglass, Inc.
  3. Johns Manville.
  4. Knauf Fiber Glass.
  5. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (blankets with kraft paper membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with kraft paper vapor-retarder membrane on 1 face.
- D. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
  1. 3-1/2 inches thick with a thermal resistance of 11 deg F x h x sq. ft./Btu at 75 deg F
  2. 5-1/2 inches thick with a thermal resistance of 21 deg F x h x sq. ft./Btu at 75 deg F
  3. 9-1/2 inches thick with a thermal resistance of 30 deg F x h x sq. ft./Btu at 75 deg F.
- E. Provide glass-fiber blanket insulation as follows:
  1. Recycled content of 20% minimum.
  2. Contain no urea-formaldehyde resins.

### **2.2 AUXILIARY INSULATING MATERIALS**

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

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

### **3.3 INSTALLATION, GENERAL**

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

### **3.4 INSTALLATION OF GENERAL BUILDING INSULATION**

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder in location indicated of construction, unless otherwise indicated.
  - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

### **3.5 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. 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 25 00  
WEATHER BARRIERS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Weather barrier membrane
- B. Seam Tape
- C. Flashing
- D. Fasteners

**1.2 REFERENCES**

- A. ASTM International
  - 1. ASTM C920; Standard Specification for Elastomeric Joint Sealants
  - 2. ASTM C1193; Standard Guide for Use of Joint Sealants
  - 3. ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting
  - 4. ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics
  - 5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials
  - 6. ASTM E96; Test Method for Water Vapor Transmission of Materials
  - 7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
  - 8. ASTM E2178; Test Method for Air Permeance of Building Materials
- B. AATCC – American Association of Textile Chemists and Colorists
  - 1. Test Method 127 Water Resistance: Hydrostatic Pressure Test
- C. TAPPI
  - 1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
  - 2. Test Method T-460; Air Resistance (Gurley Hill Method)

**1.3 SUBMITTALS**

- A. Refer to Section 01 30 00 Administrative Requirements.
- B. Product Data: Submit manufacturer current technical literature for each component.
- C. Samples: Weather Barrier Membrane, minimum 8-1/2 inches by 11 inch.
- D. Quality Assurance Submittals
  - 1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
  - 2. Manufacturer Instructions: Provide manufacturer's written installation instructions.
  - 3. Manufacturer's Field Service Reports: Provide site reports from authorized field service representative, indicating observation of weather barrier assembly installation.
- E. Closeout Submittals
  - 1. Refer to Section 01 77 00 Closeout Procedures.
  - 2. Weather Barrier Warranty: Manufacturer's executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.



## **1.4 QUALITY ASSURANCE**

### **A. Qualifications**

1. Installer shall have experience with installation of commercial weather barrier assemblies under similar conditions.
2. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.
3. Source Limitations: Provide commercial weather barrier and accessory materials produced by single manufacturer.

### **B. Mock-up**

1. Install mock-up using approved weather barrier assembly including fasteners, flashing, tape and related accessories per manufacturer's current printed instructions and recommendations.
  - a. Mock-up size: 10 feet by 10 feet.
  - b. Mock-up Substrate: Match wall assembly construction, including window opening.
  - c. Mock-up may not remain as part of the work.
2. Contact manufacturer's designated representative prior to weather barrier assembly installation, to perform required mock-up visual inspection and analysis as required for warranty.

### **C. Pre-installation Meeting**

1. Refer to Section 01300 Administrative Requirements.
2. Hold a pre-installation conference, two weeks prior to start of weather barrier installation. Attendees shall include Contractor, Architect, Engineer, Installer, Owner's Representative, and Weather Barrier Manufacturer's Designated Representative.
3. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier assembly materials and components, installer's training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Refer to Section 01 60 00 Product Requirements.
- B. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store weather barrier materials as recommended by weather barrier manufacturer.

## **1.6 SCHEDULING**

- A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.
- B. Schedule installation of weather barrier materials and exterior cladding within nine months of weather barrier assembly installation.

## **1.7 WARRANTY**

- A. Refer to Section 01 78 00 Closeout Submittals.
- B. Special Warranty

1. Special weather-barrier manufacturer's warranty for weather barrier assembly for a period of ten (10) years from date of final weather barrier installation.
2. Approval by weather barrier manufacturer for warranty is required prior to assembly installation.
3. Warranty Areas: Entire building envelope covered by Tyvek.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER**

- A. DuPont Building Innovations; 4417 Lancaster Pike, Chestnut Run Plaza 721, Wilmington, DE 19805; 1.800.44TYVEK (8-9835); <http://construction.tyvek.com>

### **2.2 MATERIALS**

- A. Basis of Design: High-performance, spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™ Tyvek® CommercialWrap® and related assembly components.
- B. Performance Characteristics:
  1. Air Penetration: 0.001 cfm/ft<sup>2</sup> at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677.
  2. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.
  3. Water Penetration Resistance: 280 cm when tested in accordance with AATCC Test Method 127.
  4. Basis Weight: 2.7 oz/yd<sup>2</sup>, when tested in accordance with TAPPI Test Method T-410.
  5. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.
  6. Tensile Strength: 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.
  7. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.
8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84. Flame Spread: 10, Smoke Developed: 10.

### **2.3 ACCESSORIES**

- A. Seam Tape: 3 inch wide, DuPont™ Tyvek® Tape for commercial applications.
  - B. Fasteners:
    1. DuPont™ Tyvek® Wrap Cap Screws, as manufactured by DuPont Building Innovations: 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer
- AND/OR
3. Masonry tap-con fasteners with Tyvek® Wrap Caps as manufactured by DuPont Building Innovations: 2-inch diameter plastic cap fasteners.
- C. Sealants
    1. Provide sealants that comply with ASTM C920, elastomeric polymer sealant to maintain watertight conditions.
    2. Products:
      - a. Tremco 830

- b. Tremco Butyl
  - c. Sealants recommended by the weather barrier manufacturer.
- D. Adhesives:
  - 1. Provide adhesive recommended by weather barrier manufacturer.
  - 2. Products:
    - a. Liquid Nails® LN-109
    - b. Polyglaze® SM 5700
    - c. Denso Butyl Liquid
    - d. 3M High Strength 90
    - e. SIA 655
    - f. Adhesives recommend by the weather barrier manufacturer.
- E. Primers:
  - 1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.
  - 2. Products:
    - a. 3M High Strength 90
    - b. Denso Butyl Spray
    - c. SIA 655
    - d. Permagrip 105
    - e. ITW TACC Sta' Put SPH
    - f. Primers recommended by the flashing manufacturer
- F. Flashing
  - 1. DuPont™ FlexWrap™, as manufactured by DuPont Building Innovations: flexible membrane flashing materials for window openings and penetrations.AND/OR
  - 2. DuPont™ StraightFlash™, as manufactured by DuPont Building Innovations: straight flashing membrane materials for flashing windows and doors and sealing penetrations such as masonry ties, etc.AND/OR
  - 3. DuPont™ StraightFlash™ VF, as manufactured by DuPont Building Innovations: dual-sided straight flashing membrane materials for brick mold and non-flanged windows and doors.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

### **3.2 INSTALLATION – WEATHER BARRIER**

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations.

- B. Install weather barrier prior to installation of windows and doors.
  - C. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
  - D. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level.
  - E. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 3-6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.
  - F. Window and Door Openings: Extend weather barrier completely over openings.
  - G. Overlap weather barrier
    - 1. Exterior corners: minimum 12 inches.
    - 2. Seams: minimum 6 inches.
  - H. Weather Barrier Attachment:
    - 1. Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommended fasteners, space 12 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.
- AND/OR
- 2. Attach weather barrier to masonry. Secure using weather barrier manufacturer recommended fasteners, spaced 12-18 inches vertically on center and 24 inches maximum horizontally. Weather barrier may be temporarily attached to masonry using recommended adhesive, placed in vertical strips spaced 24 inches on center, when coordinated on the project site.
- I. Apply 4 inch by 7 inch piece of DuPont™ StraightFlash™ to weather barrier membrane prior to the installation cladding anchors.

### **3.3 SEAMING**

- A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- B. Seal any tears or cuts as recommended by weather barrier manufacturer.

### **3.4 OPENING PREPARATION (for use with non-flanged windows – all cladding types)**

- A. Flush cut weather barrier at edge of sheathing around full perimeter of opening.
- B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

### **3.5 FLASHING (for use with non-flanged windows – all cladding types)**

- A. Cut 7-inch wide DuPont™ FlexWrap™ a minimum of 12 inches longer than width of sill rough opening. Apply primer as required by manufacturer.
- B. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- D. Apply 9-inch wide strips of DuPont™ StraightFlash™ at jambs. Align flashing with interior edge of jamb framing. Start DuPont™ StraightFlash™ at head of opening and lap sill flashing down to the sill.

- E. Spray-apply primer to top 6 inches of jambs and exposed sheathing.
- F. Install DuPont™ FlexWrap™ at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
- G. Coordinate flashing with window installation.
- H. On exterior, install backer-rod in joint between window frame and flashed rough framing. Apply sealant at jambs and head, leaving sill unsealed. Apply sealants in accordance with sealant manufacturer's instructions and ASTM C 1193.
- I. Position weather barrier head flap across head flashing. Adhere using 4-inch wide DuPont™ StraightFlash™ over the 45-degree seams.
- J. Tape top of window in accordance with manufacturer recommendations.
- K. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C 1193.

### **3.6 OPENING PREPARATION (for use with flanged windows)**

- A. Cut weather barrier in a modified "I-cut" pattern.
  - 1. Cut weather barrier horizontally along the bottom of the header.
  - 2. Cut weather barrier vertically 2/3 of the way down from top center of window opening.
  - 3. Cut weather barrier diagonally from bottom of center vertical cut to the left and right corners of the opening.
  - 4. Fold side and bottom weather barrier flaps into window opening and fasten.
- B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

### **3.7 FLASHING (for use with flanged windows)**

- A. Cut 7-inch wide DuPont™ FlexWrap™ a minimum of 12 inches longer than width of sill rough opening.
- B. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- D. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- E. Install window according to manufacturer's instructions.
- F. Apply 4-inch wide strips of DuPont™ StraightFlash™ at jambs overlapping entire mounting flange. Extend jamb flashing 1-inch above top of rough opening and below bottom edge of sill flashing.
- G. Apply 4-inch wide strip of DuPont™ StraightFlash™ as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- H. Position weather barrier head flap across head flashing. Adhere using 4-inch wide DuPont™ StraightFlash™ over the 45-degree seams.
- I. Tape head flap in accordance with manufacturer recommendations.
- J. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant

manufacturer's instructions and ASTM C 1193.

### **3.8 FIELD QUALITY CONTROL**

- A. Notify manufacturer's designated representative to obtain required periodic observations of weather barrier assembly installation.

### **3.9 PROTECTION**

- A. Protect installed weather barrier from damage.

**END OF SECTION**

**SECTION 07 31 13**  
**ASPHALT SHINGLES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Asphalt shingle roofing.
- B. Associated metal flashings and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Roof sheathing.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Edge and cap flashings.
- C. Section 07 71 23 - Manufactured Gutters and Downspouts.

**1.03 REFERENCE STANDARDS**

- A. ASTM D225 - Standard Specification for Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules; Current Edition.
- B. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; Current Edition.
- C. ASTM D3161 - Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method); Current Edition.
- D. ASTM D3462 - Standard Specification for Asphalt Shingles Made From Glass Felt and Surfaced With Mineral Granules; Current Edition.
- E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; Current Edition.
- F. ASTM D4869/D4869M - Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing; Current Edition.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; Current Edition.
- H. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; Current Edition.
- I. NRCA MS104 - The NRCA Steep Roofing Manual; National Roofing Contractors Association; Current Edition.
- J. UL (RMSD) - Roofing Materials and Systems Directory; Underwriters Laboratories Inc.; Current Edition.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating material characteristics.
- C. Samples: Submit two samples of each shingle color indicating color range and finish texture/pattern; for color selection.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with the recommendations of NRCA Steep Roofing Manual.
- B. Products Required to Comply with Fire Resistance Criteria: UL listed and labeled.

**1.06 FIELD CONDITIONS**

- A. Do not install shingles when surface temperatures are below 45 degrees F.

**PART 2 PRODUCTS**

**2.01 SHINGLES**

- A. Manufacturers:

1. GAF; Product – Royal Sovereign Series.
  2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Asphalt Shingles: Asphalt-coated glass felt, mineral granule surfaced, complying with ASTM D3462; Class A fire resistance.
1. Self-sealing type.
  2. Style: 3 Tab
  3. Basis of Design: GAF, Royal Sovereign Series.
  4. Color: Charcoal. Submit sample for final approval prior to ordering.

## **2.02 ACCESSORIES**

- A. Nails: Standard round wire shingle type, of hot-dipped zinc coated steel, 12 gage, 0.105 inch shank diameter, 3/8 inch head diameter, of sufficient length to penetrate through roof sheathing or 3/4 inch into roof sheathing or decking.
- B. Underlayment: 30 lb. felt

## **2.03 METAL FLASHINGS**

- A. Metal Flashings: Provide sheet metal eave edge, gable edge, dormer flashing, and other flashing indicated.
1. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.
  2. Hem exposed edges of flashings minimum 1/4 inch on underside.
- B. Sheet Metal: Galvanized steel, as specified in Section 07 62 00.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions prior to beginning work.
- B. Verify that deck is of sufficient thickness to accept fasteners.
- C. Verify that roof penetrations and plumbing stacks are in place and flashed to deck surface.
- D. Verify roof openings are correctly framed.
- E. Verify deck surfaces are dry, free of ridges, warps, or voids.

### **3.02 PREPARATION**

- A. Seal roof deck joints wider than 1/16 inch with deck tape.
- B. At areas where eave protection membrane is to be adhered to substrate, fill knot holes and surface cracks with latex filler.
- C. Broom clean deck surfaces before installing underlayment or eave protection.
- D. Install eave edge flashings tight with fascia boards. Weather lap joints 2 inches and seal with plastic cement. Secure flange with nails spaced 4 inches on center.

### **3.03 INSTALLATION - VALLEY PROTECTION**

- A. Weather lap joints minimum 2 inches.

### **3.04 INSTALLATION - METAL FLASHING AND ACCESSORIES**

- A. Weather lap joints minimum 2 inches and seal weather tight with plastic cement.
- B. Secure in place with nails at 4 inches on center. Conceal fastenings.
- C. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.

### **3.05 INSTALLATION - SHINGLES**

- A. Install shingles in accordance with manufacturer's instructions.
1. Fasten individual shingles using 2 nails per shingle, or as required by code, whichever is greater.



- 2. Fasten strip shingles using 4 nails per strip, or as required by code, whichever is greater.
- B. Place shingles in straight coursing pattern with 5 inch weather exposure to produce double thickness over full roof area. Provide double course of shingles at eaves.
- C. Project first course of shingles 3/4 inch beyond fascia boards.
- D. Extend shingles 1/2 inch beyond face of gable edge fascia boards.
- E. Extend shingles on both slopes across valley in a weave pattern and fasten. Extend shingles a minimum of 12 inches beyond valley center line to achieve woven valley, concealing the valley protection.
- F. Complete installation to provide weather tight service.

**END OF SECTION**

**SECTION 07 41 13**  
**STANDING SEAM METAL ROOF PANELS**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Factory-formed sheet metal roofing, including flashings and trim.
- B. Related Sections: Section(s) related to this section include:
  - 1. Cold Formed Metal Framing: Division Metal Framing Section.
  - 2. Building Insulation: Division 7 Building Insulation Section.
  - 3. Sealants: Division 7 Joint Sealants Section.
  - 4. 07 62 00 Sheet Metal Flashing

**1.2 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM A653/A653M Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 2. ASTM A792/A792M Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot Dip Process.
  - 3. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - 4. ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
  - 5. ASTM E1680 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
  - 6. ASTM E1646 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
  - 7. ASTM G90 Standard Practice for Performing Accelerated Outdoor Weathering of Non-Metallic Materials Using Concentrated Natural Sunlight.
  - 8. ASTM D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
  - 9. ASTM D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
  - 10. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials
  - 11. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
  - 12. ASTM E 2140 - Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head.
- B. Underwriters Laboratories (UL):
  - 1. UL 263 - Fire Tests of Building Construction and Materials.
  - 2. 580 - Tests for Uplift Resistance of Roof Assemblies.
  - 3. UL 790 - Standard Test Methods for Fire Tests of Roof Coverings.
  - 4. UL 2218 - Impact Resistance of Prepared Roof Covering Materials.

- C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);  
"Architectural Sheet Metal Manual"
- D. Miami-Dade County
- E. Florida Building Code
- F. Texas Windstorm Approval

### **1.3 ADMINISTRATIVE REQUIREMENTS**

#### **A. Pre-installation Meetings:**

1. Schedule meeting to discuss roof project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements before start of work onsite. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
2. Required attendees: Contractor, metal deck & roof installer, and any other subcontractors who have equipment penetrating the roof or work that requires roof access or traffic.

### **1.4 SYSTEM DESCRIPTION**

#### **A. Performance Requirements: Provide sheet metal roofing which has been manufactured, fabricated and installed to withstand structural and thermal movement, wind loading and weather exposure to maintain manufacturer's performance criteria without defects, damage, failure or infiltration of water.**

1. Air infiltration: Maximum 0.06 cfm per lineal foot (0.33 m3/hr per linear meter) of seam at static pressure of 6.24 psf (3.0 kPa) when tested per ASTM E1680.
2. Water penetration:
  - a. No uncontrolled water penetration through the joints at a static pressure of 6.24 psf (3.0 kPa) when tested in accordance with ASTM E1646.
3. Fire rating: Class A
4. Uplift Tests:
  - a. UL 580 Class 90
  - b. FM 4471 (2" only I-90)
  - c. ASTM E 1592 (1.5", 2" & 3")
5. Miami Dade: 2" x 16" only
6. Class 4 Impact Resistance: UL 2218
7. Fire Resistance: UL 263
8. Florida State Approval
9. ICC-ES: ESL 1082

#### **B. Finish Performance Requirements:**

1. Two coat coil applied, baked on full strength (70% resin, PVDF) fluorocarbon coating consisting of a nominal 0.25 mil dry film thickness primer, and a nominal dry film thickness of 0.7 -0.8 mil color coat for a total 0.9 to 1.1 mil total system dry film thickness.
2. Color change and fade resistance: No cracking, peeling, blistering or loss of adhesion when tested in accordance with ASTM G23; color change, after removal of surface deposits such as dirt or chalk, maximum 5 NBS units.

3. Humidity resistance: No blistering, peeling or loss of adhesion after 1000 hours testing, in accordance with ASTM D2247.

## **1.5 SUBMITTALS**

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit manufacturer's product data for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors and textures.
  1. Indicate layout of roofing panels and roof panel sizes, including custom-fabricated roofing panels if indicated; indicate each item of trim and accessories.
  2. Indicate in detailed drawings profile and gauge of interior and exterior sheets, and locations and types of fasteners; indicate locations, gauges, shapes and methods of attachment of roofing panels, trim and accessory items.
  3. Include Sealant location and denote those that are factory and field applied.
  4. Indicate products/materials required for construction activities and field worked conditions of this section not supplied by manufacturer of products of this section.
- E. Samples: Submit selection and verification samples for finishes, colors and textures.
  1. Selection Samples: For each product requiring color selection, 2 sets of manufacturer's sample chips representing full range of colors and finishes available.
  2. Verification Samples: For each color and finish selected, 2 chips indicating match to selected color and finish.
- F. Warranties:
  1. Substrate Warranty
  2. Finish Warranty
  3. Weather Tightness Warranty (if applicable)
- G. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.
- H. Quality Assurance Submittals: Submit the following:
  1. Contractor Certificates: Contractor's certification that:
    - a. Manufacturer of products of this section meets specified qualifications.
    - b. Installer of products of this section meets specified qualifications.
  2. Manufacturer Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements.
  3. Manufacturer's Instructions: Manufacturer's installation instructions.
  4. Manufacturer's Field Reports: Manufacturer's field reports if required.
- I. Closeout Submittals: Submit the following:
  1. Warranty: Warranty documents specified herein.

J. Buy American Certification: Manufacturer's letters of compliance indicating supplied products comply with requirements.

## **1.6 QUALITY ASSURANCE**

### **A. Manufacturer Qualifications:**

1. Provider of "hands on" installer training at manufacturer or customer facility.
2. Minimum of ten years' experience in manufacturing metal roof systems.
3. Provider of product produced in a permanent factory environment with fixed roll-forming equipment and also possesses the capability to roll form continuous panels on jobsites with a factory technician for jobs with panel lengths in excess of 50'

### **B. Installer Qualifications:**

1. At least five years' experience in the installation of structural standing seam metal roof panels.
2. Experience on at least five projects of similar size, type and complexity as this project that have been in service for a minimum of two years with satisfactory performance of the roof system.
3. Employer of workers for this project who are competent in techniques required by manufacturer for installation indicated and who shall be supervised at all times when material is being installed.
4. Certificate: When requested, submit certificate indicating qualification.

## **1.7 DELIVERY, STORAGE & HANDLING**

### **A. General: Comply with Division 1 Product Requirements Sections.**

1. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

### **B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Identify fabricated components with UL 90 label where appropriate.**

### **C. Delivery and Acceptance Requirements: Ensure all panels are received in good condition. In cases where damage is visible, note all paperwork; inform architect and project superintendent.**

### **D. Packing, Shipping, Handling and Unloading:**

1. Roofing panels to be crated to protect panels from shipping damage.
2. Package trim and accessories in waterproof wrapping paper.

### **E. Storage and Protection: Store materials protected from exposure to harmful conditions. Store material in dry, above-ground location.**

1. Stack prefinished material to prevent twisting, bending, abrasion, scratching and denting. Elevate one end of each skid to allow for moisture runoff.
2. Store products of this section in manufacturer's unopened packaging until installation of products

3. Maintain dry, heated storage area for products of this section until installation of products.
4. Remove strippable plastic film before storage under high-heat conditions.

## 1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.
- B. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

## 1.9 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
  1. Panel Material: Furnish manufacturers 45 year warranty covering the panel against rupture, structural failure, or perforation.
  2. Panel Coating: Furnish manufacturer's 40-year warranty covering cracking, checking, and peeling, and 30 year warranty covering fade and chalk on the Two coat coil applied, baked on full strength (70% resin, PVF2) fluorocarbon coating.
    - a. Manufacturer's warranty may exclude surface deterioration due to physical damage and corrosive environments.
- B. Weather Tightness Warranty
  1. Weathertightness Warranty: Manufacturers [Joint][Single Source] weathertightness warranty.
  2. Warranty Term: [5][10][15][20][25] commencing on Date of Substantial Completion.
  3. Total Manufacturers Liability: [\$0.20 (Joint Only)] [\$7.00] [\$14.00][NRL (No Repair Limit)] /sq. ft.
  4. Warranty must cover (choose all that apply) [pipe and curb penetrations][winds up to [75] [80] [90] [100] [105] [110] [120] mph
    - a. (If Penetrations are chosen) Pipes must be centered in the panel or a pipe curb must be used, Curbs must be all welded (0.0630 minimum) aluminum or 18ga. Stainless Steel.
    - b. (If Wind Rider is chosen) Manufacturer must supply engineered installation shop drawings, signed and sealed by an Engineer registered in the state in which the project is located.
- C. Special Warranty: Installer's standard form in which installer agrees to repair or replace panels that fail due to poor workmanship or faulty installation within the specified warranty period.
  1. Warranty Period: <Insert number of years> years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 Metal Roof Panels

- A. Basis of Design Manufacturer: McElroy Metal, Inc.

1. Contact: 1500 Hamilton Rd., Bossier City, LA 71111; Telephone: (800) 950-6531; Fax: (318) 747-8099; E-mail: [info@mcelroymetal.com](mailto:info@mcelroymetal.com); website: [www.mcelroymetal.com](http://www.mcelroymetal.com).
2. Proprietary Products: McElroy Metal Preformed Sheet Metal Roofing Panels.

**B. Substitutions:**

1. Basis of Design Product: Subject to compliance with requirements provide McElroy Metal Maxima
2. Substitution Limitations
  - a. Requests for approval must be submitted in writing at least ten (10) days prior to bid date, and are accompanied by all related test reports and design calculations listed in section 1.4 and Design and Performance criteria Section 2.2.
  - b. Substitute manufacturers will be approved by written addendum to all bidders. Voluntary alternates will not be considered. Substitutions will not be permitted after the bid date of this project.
  - c. Roof panels proposed for substitution shall fully comply with specified requirements in appearance, assembly, and performance.

- C. Forming: Use continuous end rolling method. No end laps are permitted on panels without architect approval. It is the intent of the Architect to provide factory-manufactured panel systems or systems manufactured on-site by factory personnel only for this project.

## **2.2 MANUFACTURED UNITS**

**A. McElroy Metal Maxima Panels:**

1. Profile: Vertical leg standing seam panel with male/female seam to be mechanically interlocked at jobsite with mechanical seamer specifically designed for Maxima profile.
2. Size: 1.5" high seam by 16" width (51 x 406 mm). Length as indicated on drawings.
3. Panel Surface: 1.5": Striated
4. Material: Galvalume steel sheet conforming to ASTM A792, AZ50 coating for bare; AZ50 coating for painted; 24 gauge sheet thickness.
5. Panels should be factory formed for lengths below 50'. To avoid lap conditions for panels greater than 50', panels should be produced on site but production must be completed by factory technicians.

## **2.3 METAL ROOF PANEL ACCESSORIES**

General: Provide complete metal roof panel assembly incorporating trim, copings, fascia, gutters and downspouts, and miscellaneous flashings, in manufacturer's standard profiles. Provide required fasteners, closure strips, splice plates, support plates, and sealants as indicated in manufacturer's written instructions.

- A. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.
- B. Panel Clips: ASTM A 653/A 653M, G90 (Z180) hot-dip galvanized zinc coating, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.
- C. Panel Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by roof panel manufacturer. Where exposed fasteners cannot be avoided,

supply fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of factory-applied coating.

- D. Joint Sealers: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows:
  - 1. Factory-Applied Seam Sealant: Manufacturer's standard hot-melt type.
  - 2. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.
  - 3. Concealed Joint Sealant: Non-curing butyl, AAMA 809.2.
- E. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized zinc coating.
- F. Roof Accessories: Approved by metal roof panel manufacturer. Refer to [Section 07 72 00] "Roof Accessories" for requirements for roof accessories.
- G. Snow Guards: Approved by metal roof panel manufacturer. Refer to [Section 07 72 53] "Snow Guards" for requirements for snow guards attached to metal roof panels

## **2.4 FABRICATION**

- A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Fabricate metal panel joints configured to accept factory-applied sealant providing weathertight seal and preventing metal-to-metal contact and minimizing noise resulting from thermal movement.
- C. Form panels in continuous lengths for full length of detailed runs, except where otherwise indicated on approved shop drawings.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings. Form from materials matching metal panel substrate.

## **2.5 FINISHES**

- A. Two coat coil applied, baked on full strength (70% resin, PVF2) fluorocarbon coating consisting of a nominal 0.25 mil dry film thickness primer, and a nominal dry film thickness of 0.7 -0.8 mil color coat for a total 0.9 to 1.1 mil total system dry film thickness. Finish to be selected from manufacturer's standard color selection. The back side of the material should be 0.25 mil primer and a 0.25 mil polyester wash coat.
  - 1. Roof Panel Color:
    - a. Selected from full range of manufacturer's standard colors.
    - b. Color: Ash Gray.
  - 2. Roof Related Trim/Accessories Color:
    - c. Selected from full range of manufacturer's standard colors.
    - d. Color: Ash Gray

## **2.6 RELATED MATERIALS**



A. General: Coordinate use of related materials:

1. Underlayment: Refer to Division 7 Roofing Section
2. Plywood Deck: Refer to Division 6 Rough Carpentry Section
3. Sealants: Refer to Division 7 Joint Sealants Section

## **2.7 SOURCE QUALITY**

- A. Source Quality: Obtain metal panel products from a single manufacturer.
- B. Quality Control: Obtain structural standing seam metal roof panels, trim and other accessories from a manufacturer capable of providing on-site technical support and installation assistance.

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- A. Compliance: Comply with manufacturer's product data, recommendations and installation instructions for substrate verification, preparation requirements and installation.
1. Strippable Film: Remove manufacturer's protective film, if any, from surfaces of roofing panels.
- B. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
1. Verification of Conditions:
    - a. Panel support systems are ready for construction activities of this section and within specified tolerances.
    - b. Rough-in utilities are in correct locations.
  2. Installer's Examination:
    - a. Have installer of this section examine conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable.
    - b. Transmit 2 copies of installer's report to Architect within 24 hours of receipt.
    - c. Delay construction activities of this section until unacceptable conditions have been corrected.
    - d. Beginning construction activities of this section indicates installer's acceptance of conditions.

### **3.2 PREPARATION**

- A. Coordination: Coordinate metal roofing with other work to provide a noncorrosive and leak-proof installation.
1. Install substrate boards, hat channels, purlins, or furring channels in accordance with manufacturer's recommendations.
  2. Coordinate work, with installation of other associated Work, to ensure quality application.
  3. Coordinate work with installation of associated metal flashings and building walls.

4. Coordinate work to minimize foot traffic and construction activity on installed finished surfaces.
5. Coordinate location of pipe penetrations to allow centering of pipe in panel.
6. Coordinate location of roof curbs, to allow proper integration with roof panel.
7. Coordinate work to minimize foot traffic and construction activity on installed finished surfaces.
8. Dissimilar Metals: Prevent galvanic action of dissimilar metals.

### **3.3 INSTALLATION**

A. General: Install metal roofing panels to profiles, patterns and drainage indicated and required for leak-proof installation. Provide for structural and thermal movement of work. Seal joints for leak-proof installation.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws.
3. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
4. Install screw fasteners in predrilled holes for clip installation.
5. Locate and space fasteners in uniform vertical and horizontal alignment.
6. Install flashing and trim as metal panel work proceeds.
7. Install continuous length panels if at all possible. If splices are required, locate panel splices over, but not attached to, structural supports.
8. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws.
9. Fasten flashings and trim around openings and similar elements with self-tapping screws.
10. Provide weathertight EPDM Flashing for pipe- and conduit-penetrating panels.
11. Seams: Provide uniform, neat seams.
12. Fix panels at location depicted on reviewed shop drawings.
13. Allow for required panel clearance at penetrations for thermal movement.
14. Align pipe penetrations to occur at center of roof panel. Report and have corrected improperly placed penetrations before proceeding with panel installation. Remove and replace roof panels which have improperly placed penetration flashings.
15. Allow for required panel clearance at penetrations for thermal movement.
16. Fasteners: Conceal fasteners where possible in exposed work. Cover and seal fasteners and anchors for watertight and leak-proof installation.
17. Sealant-Type Joints: Provide sealant-type joint where indicated. Form joints to conceal sealant. Comply with Division 7 Joint Sealants Section for sealant installation.

B. Roofing Installation:

1. Install roofing plumb, true and in correct alignment with structural framing, in accordance with shop drawings and manufacturer's printed installation instructions.
2. Install roofing using manufacturer's concealed fastening system or non-corroding fasteners color-matched to panel.
3. Install trim using concealed fasteners where possible; sight-exposed non-corroding fasteners color-matched to trim are permitted on vertical surfaces only.

C. Installation Tolerances:

1. Variation from Plumb: Maximum 1/8" (3.2 mm) in 20 feet (6.096 m).
2. Variation from Level: Maximum 1/8" (3.2 mm) in 20 feet (6.096 m).
3. Variation from True Plane: Maximum 1/4" (3.2 mm) in 20 feet (6.096 m).

**D. Underlayment Installation**

1. Underlayment to be supplied by metal roof panel manufacturer.
2. Self-adhered High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
3. Thermal Stability: Stable after testing at 240 degree F; ASTM D1970.
4. Low-Temperature Flexibility: Passes after testing at minus 20 degree F; ASTM D1970.
5. Supplied by metal roof panel manufacturer.
  - a. Apply over the entire roof surface.
  - a. Roof perimeter for a distance up from eaves of 24 inches beyond interior wall line.
  - b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches. Overlap ends of sheets not less than 6 inches.
  - c. Rake edges for a distance of 18 inches.
  - d. Hips and ridges for a distance on each side of 18 inches.
  - e. Roof-to-wall intersections for a distance from wall of 18 inches.
  - f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches.

E. Accessory Installation: Install accessories using techniques recommended by manufacturer and which will assure positive anchorage to building and weathertight mounting. Provide for thermal movement. Coordinate installation with flashings and other components

F. Flashing and Trim Installation: Comply with performance requirements, manufacturer's written installation instructions, and the SMACNA "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and install units to true level. Install work with laps, joints, and seams that will be permanently watertight.

G. Metal Roof Curbs: .063 minimum thickness welded aluminum, or 18 gauge minimum welded stainless steel, factory-insulated, with integral cricket, and designed to fit roof panel module, sized to meet specification.

### **3.4 FIELD QUALITY REQUIREMENTS**

- A. Site Tests: (Post-Installation Testing): Owner reserves right to perform post-installation testing of installed metal panel installation.
- B. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

### **3.5 CLEANING**

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas.
- B. Repair or replace damaged installed products.
- C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

- D. Remove construction debris from project site and legally dispose of debris.
- E. Remove strippable coating and perform dry wipe-down cleaning of panels as erected.

### **3.6 PROTECTION**

- A. Protection: Protect installed product's finish surfaces from damage during construction:
  - 1. Protect installed products from damage by subsequent construction activities.
  - 2. Replace products having damage other than minor finish damage.
  - 3. Repair products having minor damage to finish in accordance with panel Manufacturer's recommendation
  - 4. Architect shall be sole judge of acceptability of repair to damaged finishes; replace products having rejected repairs

**END OF SECTION**

**SECTION 07 46 46  
FIBER CEMENT SIDING**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Fiber cement siding panels with battens, soffits, lap siding, fascia, moulding & trim and accessories.

**1.2 RELATED SECTIONS**

- A. Section 06 10 00 – Rough Carpentry: Wood framing and bracing.
- B. Section 07 21 00 – Thermal Insulation: Exterior wall insulation.

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 4 by 6 inches (100 by 150 mm), representing actual product, color, and patterns.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Minimum of 2 years experience with installation of similar products.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

**1.6 PROJECT CONDITIONS**

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

## **1.7 WARRANTY**

- A. Product Warranty: Limited product warranty against manufacturing defects.
  - 1. Hardieplank lap and Hardipanel vertical siding for 50 years.
  - 2. HardieTrim for 10 years.
- B. Finish Warranty: Limited product warranty against manufacturing finish defects.
  - 1. When used for its intended purpose, properly installed and maintained according to Hardie's published installation instructions, James Hardie's ColorPlus finish with ColorPlus Technology, for a period of 15 years from the date of purchase: will not peel; will not crack; and will not chip.
- C. Workmanship Warranty: Application limited warranty for 2 years.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Design Manufacturer: James Hardie Building Products, Inc; 26300 La Alameda, Suite 250, Mission Viejo, CA 92691. ASD. Toll Free Residential: (888) J-HARDIE. Toll Free Commercial: (866) 274-3464. Tel: (949) 348-1800. Fax: (949) 367-0185. Email: info@JamesHardie.com. Web - Residential: <http://www.jameshardie.com>. Web - Commercial: <http://www.jameshardiecommercial.com>.
- B. Requests for approval of equal substitutions will be considered in accordance with provisions of Section 01 30 00.

### **2.2 SIDING**

- A. Code Compliance Requirement for Materials:
  - 1. National Evaluation Report No. NER 405 (BOCA, ICBO, SBCCI)
  - 2. City of Los Angeles, Research Report No. 24862
  - 3. Metro Dade County, Florida Acceptance No. 07-0148, 04
  - 4. US Department of Housing and Urban Development Materials Release 1263d
  - 5. California DSA PA-019.
  - 6. City of New York M EA 223-93-M.
  - 7. Non-asbestos fiber-cement siding where required to be non-combustible shall be tested in accordance with ASTM E136.
- B. Trim: Hardietrim Fascia and Moulding as manufactured by James Hardie Building Products, Inc.

### **2.3 FASTENERS**

- A. Wood Framing:
  - 1. Refer to manufacturer's installation guidelines.

## **2.4 FINISHES**

- A. Factory Primer: Provide factory applied universal primer.
  - 1. Primer: PrimePlus by James Hardie.
  - 2. Topcoat: Refer to Section 09 91 00 and Exterior Finish Schedule.
- B. Field Finish all panels per Section 3.4 Finishing below.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Nominal 2 inch by 4 inch (51 mm by 102 mm) wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-resistive barriers or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.
  - 1. Install water-resistive barriers and claddings to dry surfaces.
  - 2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
  - 3. Protect siding from other trades.
- D. Minimum 20 gauge 3-5/8 inch (92 mm) C-Stud 16 inches maximum on center or 16 gauge 3-5/8 inches (92 mm) C-Stud 24 inches (610 mm) maximum on center metal framing complying with local building codes, including the use of water-resistive barriers and/or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.
  - 1. Install water-resistive barriers and claddings to dry surfaces.
  - 2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
  - 3. Protect siding from other trades.

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION - HARDIETRIM SOFFIT, FASCIA AND MOULDING**

- A. Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.
- B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch (19 mm) or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.

- C. Place fasteners no closer than 3/4 inch (19 mm) and no further than 2 inches (51 mm) from side edge of trim board and no closer than 1 inch (25 mm) from end. Fasten maximum 16 inches (406 mm) on center.
- D. Maintain clearance between trim and adjacent finished grade.
- E. Trim inside corner with single board.
- F. Outside Corner Board: For 3/4 inch (19 mm) trim only. Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten Hardietrim board to Hardietrim board.
- G. Outside Corner Board: For 1 inch (25 mm) and 1-1/2 inches (38 mm) trim only. Pre Build corners by fastening trim together with 16 ga. corrosion resistant finish nail 1/2 inch (13 mm) from edge spaced 16 inches (406 mm) apart, weather cut each end spaced minimum 12 inches (305 mm) apart.
- H. Allow 1/8 inch gap between trim and siding.
- I. Seal gap with high quality, paint-able caulk.
- J. Shim frieze board as required to align with corner trim.
- K. Install Hardietrim fascia over structural subfascia.
- L. Overlay siding with Hardietrim moulding at windows, doors and inside corners.
- M. Fasten through overlapping boards. Do not nail between lap joints.
- N. Overlay siding with single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten Hardietrim boards to Hardietrim boards.
- O. Shim frieze board as required to align with corner trim.
- P. Install Hardietrim fascia over structural sub-fascia.

### **3.4 FINISHING**

- A. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

### **3.5 PROTECTION**

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

## **END OF SECTION**



**SECTION 07 62 00**  
**SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
- B. Reglets and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Wood nailers.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking for batten seams.
- C. Section 07 92 00 - Joint Sealers.
- D. Sections 09 91 13 & 09 91 23 - Painting and Coating: Field painting.

**1.03 REFERENCE STANDARDS**

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2002.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012)e1.
- D. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

**1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

## **1.06 PRE-INSTALLATION CONFERENCE**

- A. Convene one week before starting work of this section.

## **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

## **PART 2 PRODUCTS**

### **2.01 SHEET MATERIALS**

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal.
- B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal, shop pre-coated with modified silicone coating.
  - 1. Modified Silicone Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.
- C. Pre-Finished Aluminum: ASTM B 209 (ASTM B 209M); 0.032 inch thick; plain finish shop pre coated with fluoropolymer coating of color as selected.
  - 1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as scheduled.

### **2.02 ACCESSORIES**

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Sealant: Type specified in Section 07 90 05.
- E. Plastic Cement: ASTM D4586, Type I.

### **2.03 FABRICATION**

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

### **3.02 PREPARATION**

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

### **3.03 INSTALLATION**

- A. Conform to drawing details.
- B. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.
- C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- D. Apply plastic cement compound between metal flashings and felt flashings.
- E. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- F. Seal metal joints watertight.
- G. Secure gutters and downspouts in place using concealed fasteners.
- H. Slope gutters 1/4 inch per foot minimum.

- I. Connect downspouts to downspout boots. Grout connection watertight.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

**END OF SECTION**

**SECTION 07 71 00  
ROOF SPECIALTIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
1. Copings.
  2. Roof-edge specialties.
  3. Roof-edge drainage systems.
  4. Reglets and counterflashings.
- B. Related Requirements:
1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
  2. Section 07 54 19 "Polyvinyl-Chloride (PVC) Roofing" for custom- and site-fabricated sheet metal flashing and trim, and roof-edge conditions.
  3. Section 07 62 00 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
  4. Section 07 72 00 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
  5. Section 07 92 00 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
- C. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, or Owner's Representative, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
  2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

**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.
- B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
  2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
  3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
  4. Detail termination points and assemblies, including fixed points.
  5. Include details of special conditions.
- C. Samples: For each type of roof specialty and for each color and texture specified.
- D. Samples for Initial Selection: For each type of roof specialty indicated with factory- applied color finishes.
- E. Samples for Verification:
1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
  2. Include copings, roof-edge specialties, roof-edge drainage systems, reglets and counterflashings made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.
- C. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranty.

#### **1.5 CLOSEOUT SUBMITTALS**

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

#### **1.6 QUALITY CONTROL**

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.
- B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 07 54 19 "Polyvinyl-Chloride (PVC) Roofing".
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
1. Build mockup of typical roof edge, including fascia, gutter and downspout, approximately 10 feet (3.0 m) long, including supporting construction, seams, attachments, underlayment, and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner or Owner's Representative specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

## **1.8 FIELD CONDITIONS**

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide aleakproof, secure, and noncorrosive installation.

## **1.9 WARRANTY**

- A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according toASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Finish Warranty Period: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastenerdisengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties

tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on the Structural Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## **2.2 ROOF-EDGE SPECIALTIES**

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 2 feet (3.6 m) and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Berridge Manufacturing Company.
    - b. Hickman Company, W. P.
    - c. Metal-Era, Inc.
  2. Metallic-Coated Steel Sheet Fascia Covers: Zinc-coated (galvanized) steel, nominal thickness as required to meet performance requirements.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Owner or Owner's Representative from manufacturer's full range.

## **2.3 ROOF-EDGE DRAINAGE SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Cheney Flashing Company.
  2. Hickman Company, W. P.
  3. Merchant & Evans Inc.
- B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Zinc-Coated Steel: Nominal 0.034-inch (0.86-mm) thickness.



2. Gutter Profile: As indicated on the drawings and in accordance with SMACNA's "Architectural Sheet Metal Manual."
  3. Corners: Factory mitered and mechanically clinched and sealed watertight.
  4. Gutter Supports: Gutter brackets or Manufacturer's standard supports asselected by Owner or Owner's Representative with finish matching the gutters.
- C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Zinc-Coated Steel: Nominal 0.034-inch (0.86-mm) thickness.
- D. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch- (100-mm-)wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
- E. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout, exterior flange trim, and built-in overflow.
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
- F. Splash Pans: Fabricate from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
- G. Zinc-Coated Steel Finish: Two-coat fluoropolymer.
1. Color: As selected by Owner or Owner's Representative from manufacturer's full range.

## **2.4 REGLETS AND COUNTERFLASHINGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Berridge Manufacturing Company.
  2. Fry Reglet Corporation.
  3. Heckmann Building Products, Inc.
  4. Hickman Company, W. P.
- B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
  2. Corners: Factory mitered and mechanically clinched and sealed watertight.
  3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  4. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.

5. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
  6. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
  7. Multiuse Type, Embedded: For multiuse embedment in cast-in-place concrete or masonry mortar joints.
- C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
- D. Accessories:
1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
  2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- E. Zinc-Coated Steel Finish: Two-coat fluoropolymer.
1. Color: As selected by Owner or Owner's Representative from manufacturer's full range.

## **2.5 MATERIALS**

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

## **2.6 MISCELLANEOUS MATERIALS**

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
  2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D

1187/D 1187M.

- E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## **2.7 FINISHES**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a stripable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Coil-Coated Galvanized-Steel Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 UNDERLAYMENT INSTALLATION**

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2

inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under copings, roof-edge specialties and reglets and counterflashings.
  2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.
- B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

### **3.3 INSTALLATION, GENERAL**

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  4. Torch cutting of roof specialties is not permitted.
  5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
  2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws or substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

### **3.4 ROOF-EDGE SPECIALITIES INSTALLATION**

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

### **3.5 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION**

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 30 inches (762 mm) apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
  - 1. Install gutter with expansion joints at locations indicated but not exceeding 50feet (15.2 m) apart. Install expansion-joint caps.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.
  - 1. Provide elbows at base of downspouts at grade to direct water away from building.
  - 2. Connect downspouts to underground drainage system indicated.
- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant.
- E. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
  - 1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
  - 2. Loosely lock front edge of scupper with conductor head.
  - 3. Seal or solder exterior wall scupper flanges into back of conductor head.
- F. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch (25 mm) below scupper discharge.

### **3.6 REGLET AND COUNTERFLASHING INSTALLATION**

- A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

- B. Embedded Reglets: See Section 03 30 00 "Cast-in-Place Concrete" and Section 04 20 00 "Unit Masonry" for installation of reglets.
- C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.
- D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

### **3.7 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

### **END OF SECTION**

## **SECTION 07 92 00 JOINT SEALERS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Sealants and joint backing.
- B. Precompressed foam sealers.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 08 80 00 - Glazing: Glazing sealants and accessories.

#### **1.03 SUBMITTALS**

- A. See Section 01 30 00 – Submittal Procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

#### **1.05 FIELD CONDITIONS**

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

#### **1.06 COORDINATION**

- A. Coordinate the work with all sections referencing this section.

#### **1.07 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Silicone Sealants:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com](http://www.momentive.com).
  - 3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 4. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Polyurethane Sealants:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 3. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Acrylic Sealants (ASTM C920):
  - 1. Tremco Global Sealants: [www.tremcosealants.com](http://www.tremcosealants.com).
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.

- D. Butyl Sealants:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Acrylic Emulsion Latex Sealants:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 3. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Preformed Compressible Foam Sealers:
  - 1. EMSEAL Joint Systems, Ltd: [www.emseal.com](http://www.emseal.com).
  - 2. Sandell Manufacturing Company, Inc: [www.sandellmfg.com](http://www.sandellmfg.com).
  - 3. Dayton Superior Corporation: [www.daytonsuperior.com](http://www.daytonsuperior.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.02 SEALANTS

- A. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single component.
  - 1. Color: Standard colors matching finished surfaces.
  - 2. Applications: Use for:
    - a. Control, expansion, and soft joints in masonry.
    - b. Joints between concrete and other materials.
    - c. Joints between metal frames and other materials.
    - d. Other exterior joints for which no other sealant is indicated.
- B. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
  - 1. Applications: Use for:
    - a. Concealed sealant bead in sheet metal work.
    - b. Concealed sealant bead in siding overlaps.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
  - 1. Applications: Use for:
    - a. Interior wall and ceiling control joints.
    - b. Joints between door and window frames and wall surfaces.
    - c. Other interior joints for which no other type of sealant is indicated.
- D. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
  - 1. Applications: Use for:
    - a. Joints between plumbing fixtures and floor and wall surfaces.
    - b. Joints between kitchen and bath countertops and wall surfaces.
- E. Acoustical Sealant for Concealed Locations: Permanently tacky non-hardening butyl sealant.
  - 1. Applications: Use for concealed locations only:
    - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.



## **2.03 ACCESSORIES**

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces and joint openings are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

### **3.03 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
  - 1. Width/depth ratio of 2:1.
  - 2. Neck dimension no greater than 1/3 of the joint width.
  - 3. Surface bond area on each side not less than 75 percent of joint width.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.

### **3.04 CLEANING**

- A. Clean adjacent soiled surfaces.

### **3.05 PROTECTION**

- A. Protect sealants until cured.

**END OF SECTION**

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

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Non-fire-rated frames.
- B. Steel frames for wood doors.
- C. Steel glazing frames.
- D. Accessories, including glazing.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 90 00 - Painting and Coating: Field painting.

**1.03 REFERENCE STANDARDS**

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2011).
- D. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 – Submittal Procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Steel Frames:
  - 1. Assa Abloy Ceko, Curries, or Fleming: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 FRAMES**

- A. Requirements for All Frames:
  - 1. Accessibility: Comply with ANSI/ICC A117.1.
  - 2. Finish: Factory primed, for field finishing.

3. Corners: Mitered, factory welded.

## **2.03 STEEL DOORS**

- A. Exterior Doors, Non-Fire-Rated:
  1. Grade: ANSI A250.8 Level 1, physical performance Level C, Model 1, full flush.
  2. Core: Cardboard honeycomb.
  3. Thickness: 1-3/4 inches.
  4. Texture: Smooth faces.
  5. Finish: Factory primed, for field finishing.

## **2.04 STEEL FRAMES**

- A. General:
  1. Comply with the requirements of grade specified for corresponding door.
    - a. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage
  2. Finish: Factory primed, for field finishing.
  3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
  4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
  5. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top. Fully welded type.
- B. Interior Door Frames, Non-Fire-Rated: Fully welded type.
  1. Finish: Factory primed, for field finishing.
- C. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

## **2.05 ACCESSORY MATERIALS**

- A. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- B. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

## **2.06 FINISH MATERIALS**

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

# **PART 3 EXECUTION**

## **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

## **3.02 PREPARATION**

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

## **3.03 INSTALLATION**

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. Coordinate frame anchor placement with wall construction.
- C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- D. Coordinate installation of hardware.
- E. Coordinate installation of glazing.

F. Coordinate installation of electrical connections to electrical hardware items.

**3.04 TOLERANCES**

A. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

**3.05 ADJUSTING**

A. Adjust for smooth and balanced door movement.

**END OF SECTION**

**SECTION 08 31 00  
ACCESS DOORS AND PANELS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wall access door and frame units.
- B. Ceiling access door and frame units.

**PART 2 PRODUCTS**

**2.01 ACCESS DOOR AND PANEL APPLICATIONS**

- A. Walls, Unless Otherwise Indicated:
  - 1. Material: Stainless Steel.
  - 2. Size: 18 by 18 inch, unless otherwise indicated.
  - 3. Standard duty, hinged door.
  - 4. Key-operated spring or cam lock; no handle.
  - 5. Insulated.
  - 6. In Masonry: Surface mounted frame with door surface flush with frame surface.

**2.02 WALL AND CEILING UNITS**

- A. Manufacturers:
  - 1. ACUDOR Products Inc: [www.acudor.com](http://www.acudor.com).
- B. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies that units are to be installed in.
  - 1. Door Style: Single thickness with rolled or turned in edges.
  - 2. Steel Finish: Primed.
  - 3. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
  - 4. Hardware:
    - a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
    - b. Latch/Lock: Cylinder lock operated cam latch, two keys for each unit.

**END OF SECTION**

**SECTION 08 33 00**  
**ROLLING SERVICE DOORS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Rolling service doors.

**1.2 REFERENCES**

- A. ANSI/DASMA 108 - American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.
- B. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

**1.3 DESIGN / PERFORMANCE REQUIREMENTS**

- A. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Details of construction and fabrication.
  - 4. Installation instructions.
- C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.
- B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

#### **1.7 PROJECT CONDITIONS**

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

#### **1.8 COORDINATION**

- A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

#### **1.9 WARRANTY**

- A. Warranty: Manufacturer's limited door system warranty for 2 years for all parts and components.
- B. PowderGuard Finish
  - 1. PowderGuard Premium Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.



## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturer: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: [www.overheaddoor.com](http://www.overheaddoor.com). E-mail: [info@overheaddoor.com](mailto:info@overheaddoor.com).
- B. Substitutions:
  - 1. C.H.I Overhead Doors, [www.chiohd.com](http://www.chiohd.com)
  - 2. Cookson Doors, [www.cooksondoor.com](http://www.cooksondoor.com)
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

### **2.2 ROLLING SERVICE DOORS**

- A. Light Commercial Doors: Overhead Door Corporation, Model 600 Coil-Away Rolling Service Doors.
  - 1. Curtain: Interlocking roll-formed galvanized steel slats, flat crown profile type CAW, 26 gauge for widths up to 12 feet 4 inches (3.75 m), 24 gauge for widths up to 16 feet (4.88 m). End of each slat shall be locked from lateral movement by a staking lock system.
  - 2. Finish:
    - a. Curtain slats and hood shall be galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on powder coated top coat.
      - 1) Powder Coat:
        - (a) PowderGuard Premium: Powder coat color as selected by the Architect.
      - 2) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
  - 3. Weatherseals: Vinyl bottom seal.
  - 4. Bottom Bar: Extruded aluminum.
  - 5. Guides: Roll-formed galvanized steel shapes attached to continuous galvanized steel wall angle.
    - a. Finish: PowderGuard Premium powder coat, color as selected by Architect.
  - 6. Brackets: Galvanized steel to support counterbalance and curtain.
    - a. Finish: PowderGuard Premium powder coat, color as selected by Architect.
  - 7. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel and supporting the curtain with deflection limited to 0.03 inch per foot of span. Spring tension shall be adjustable.
  - 8. Hood: 24 gauge galvanized steel with intermediate supports as required.
  - 9. Manual Operation:
    - a. Manual push up for doors up to 100 SF.
  - 10. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
  - 11. Locking:
    - a. Two interior bottom bar slide bolts for manually operated doors.

12. Wall Mounting Condition: Face-of-wall.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.
- G. Install perimeter trim and closures.
- H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

### **3.4 ADJUSTING**

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

### **3.5 CLEANING**

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

### **3.6 PROTECTION**

- A. Protect installed products until completion of project.

**END OF SECTION**

**SECTION 08 33 23**  
**ROLLING COUNTER DOORS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Rolling Counter Doors, manually operated.

**1.2 RELATED SECTIONS**

- A. Section 05500 - Metal Fabrications: Support framing and framed opening.
- B. Section 08710 - Door Hardware: Product Requirements for cylinder core and keys.
- C. Section 09900 - Painting: Field applied finish.

**1.3 REFERENCES**

- A. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- C. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Details of construction and fabrication.
  - 4. Installation methods.
- C. Shop Drawings: Include detailed plans, elevations, details of framing members, required clearances, anchors, and accessories. Include relationship with adjacent construction.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.

- B. Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

## **1.7 PROJECT CONDITIONS**

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

## **1.8 COORDINATION**

- A. Coordinate Work with other operations and installation of adjacent finish materials to avoid damage to installed materials.

## **1.9 WARRANTY**

- A. Warranty: Manufacturer's limited door warranty for 2 years for all parts and components.
- B. PowderGuard Finish.
  - 1. PowderGuard Premium Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.

# **PART 2 PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Acceptable Manufacturer: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: [www.overheaddoor.com](http://www.overheaddoor.com). E-mail: [info@overheaddoor.com](mailto:info@overheaddoor.com).
- B. Substitutions:
  - 1. C.H.I Overhead Doors, [www.chiohd.com](http://www.chiohd.com)
  - 2. Cookson Doors, [www.cooksondoor.com](http://www.cooksondoor.com)
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

## **2.2 ROLLING STEEL COUNTER DOORS**

- A. Galvanized Steel Counter Doors: Overhead Door Corporation, Model 650
  - 1. Wall Mounting Condition:
    - a. Face-of-wall mounting.

2. Curtain: Interlocking slats, Type F-158 fabricated of 22 gauge galvanized steel. Endlocks attached to alternate slats to maintain curtain alignment and prevent lateral slat movement.
3. Finish:
  - a. Slats and hood galvanized steel in accordance with ASTM A 653 with rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on powder coated top coat.
    - 1) Powder Coat:
      - (a) PowderGuard Premium powder coat, color as selected by the Architect.
  - b. Non-galvanized exposed ferrous surfaces for guides, bottom bar and head plates shall receive one coat of rust-inhibitive primer.
4. Bottom Bar:
  - a. Steel tubular locking bottom bar with weatherstrip.
5. Guides: Extruded aluminum.
6. Brackets: Steel plate to support counterbalance, curtain and hood.
7. Finish; Bottom Bar, Guides, Brackets:
  - a. Finish: PowderGuard Zinc base coat, gray with PowderGuard Premium powder coat color as selected by the Architect.
8. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel.
9. Hood: Provided with intermediate support brackets as required and fabricated of:
  - a. Galvanized primed steel.
10. Operation:
  - a. Manual push up.
11. Locking:
  - a. Slide bolt locks suitable for use with padlock.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.
- G. Install perimeter trim and closures.

### **3.4 ADJUSTING**

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

### **3.5 CLEANING**

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

### **3.6 PROTECTION**

- A. Protect installed products until completion of project.

**END OF SECTION**

## **SECTION 08 71 00 DOOR HARDWARE**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Hardware for interior wood and exterior wood and metal doors.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 08 11 13 – Hollow Metal Doors and Frames.

#### **1.03 REFERENCE STANDARDS**

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. BHMA A156.2 - American National Standard for Bored and Preamsembled Locks & Latches; Builders Hardware Manufacturers Association; 2011 (ANSI/BHMA A156.2).
- C. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc.; 2008 (ANSI/BHMA A156.4).
- D. BHMA A156.6 - American National Standard for Architectural Door Trim; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.6).
- E. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; Builders Hardware Manufacturers Association, Inc.; 2010 (ANSI/BHMA A156.8).
- F. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.18).
- G. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012 (ANSI/BHMA A156.22).
- H. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; Door and Hardware Institute; 1993; also in WDHS-1/WDHS-5 Series, 1996.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Convey Owner's keying requirements to manufacturers.
- D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.

#### **1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
- C. Samples: Prior to preparation of hardware schedule:
  - 1. Submit 1 sample of hinge and passage closer illustrating style, color, and finish.
  - 2. Samples will not be returned to supplier.



## **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with 10 years of experience.
- C. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

## **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

## **1.08 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

# **PART 2 PRODUCTS**

## **2.01 MANUFACTURERS - BASIS OF DESIGN**

- A. Richelieu – no substitutions per the request of the Owner.

## **2.02 DOOR HARDWARE - GENERAL**

- A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide all items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
  - 1. Applicable provisions of federal, state, and local codes.
  - 2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
  - 3. Applicable provisions of NFPA 101, Life Safety Code.
- D. Function: Lock and latch function descriptions of manufactures series as listed in hardware schedule.
- E. Finishes: All door hardware the same finish unless otherwise indicated.
  - 1. Primary Finish: Refer to Hardware Schedule on the drawings.

## **2.03 HINGES**

- A. Hinges: Provide hinges on every swinging door.
  - 1. Provide five-knuckle full mortise butt hinges unless otherwise indicated, three hinges per door.
  - 2. Provide ball-bearing hinges at all doors.
  - 3. Provide hinges in the quantities indicated.
- B. Manufacturers - Hinges:
  - 1. Assa Abloy McKinney: [www.assaabloydss.com](http://www.assaabloydss.com).

## **2.05 LOCKS AND LATCHES**

- A. Locks: As indicated in the Hardware Schedule.
  - 1. Hardware Sets indicate locking functions required for each door.
  - 2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim. Refer to Hardware Schedule.
- B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.

1. Provide cams and/or tailpieces as required for locking devices required.
- C. Keying: Grand master keyed.
  1. Include construction keying.
  2. Supply keys in the following quantities:
    - a. 5 master keys.
    - b. 5 grand master keys.
    - c. 2 construction keys.
    - d. 2 control keys and 2 extra cylinder cores.
    - e. 2 change keys for each lock.
- D. Occupancy Indicator: ML2030 by Assa Abloy

## **2.09 STOPS AND HOLDERS**

- A. Stops: As noted in the Hardware Schedule.

## **2.10 GASKETING AND THRESHOLDS**

- A. Gasketing and Thresholds: As noted on the Hardware Schedule.

## **2.11 PROTECTION PLATES AND ARCHITECTURAL TRIM**

- A. Protection Plates:
  1. Kickplate: As noted in the Hardware Schedule.

## **2.12 KEY CONTROLS**

- A. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
- B. Facility Manager's Key Cabinet: Sheet steel construction, piano hinged door with key lock.
  1. Mounting: Wall-mounted.
  2. Capacity: Actual quantity of keys, plus 25 percent additional capacity.
  3. Size key hooks to hold 6 keys each.
  4. Finish: Baked enamel, manufacturer's standard color.
  5. Key cabinet lock to building keying system.
- C. Fire Department Lock Box: This item shall be specified by the fire department having local jurisdiction. The contractor shall coordinate the order, delivery and shall install item in a designated location. Contractor shall provide payment for item, including tax and freight, and installation. .

## **2.13 GENERAL REQUIREMENTS FOR DOOR HARDWARE PRODUCTS**

- A. Provide products that comply with the following:
  1. Applicable provisions of Federal, State, and local codes.
  2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
  3. Applicable provisions of NFPA 101, Life Safety Code.
- B. Finishes: Identified in schedule on the drawings.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.

### **3.02 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.

- C. Mounting heights for hardware from finished floor to center line of hardware item:
  - 1. For wood doors: Comply with DHI "Recommended Locations for Architectural Hardware for Wood Flush Doors."

### **3.03 FIELD QUALITY CONTROL**

- A. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

### **3.04 ADJUSTING**

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust hardware for smooth operation.

### **3.05 CLEANING**

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

### **3.06 PROTECTION**

- A. Protect finished Work under provisions of Section 01 70 00.
- B. Do not permit adjacent work to damage hardware or finish.

### **3.07 SCHEDULE - REFER TO DRAWINGS.**

**END OF SECTION**

**SECTION 08 91 00  
LOUVERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Louvers, frames, and accessories.

**1.02 REFERENCE STANDARDS**

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2010.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2012.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.

**1.03 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.
- D. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.
- E. Test Reports: Independent agency reports showing compliance with specified performance criteria.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

**1.05 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide twenty year manufacturer warranty against distortion, metal degradation, and failure of connections.
  - 1. Finish: Include coverage against degradation of exterior finish.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Wall Louvers:
  - 1. Airolite Company, LLC: [www.airolite.com](http://www.airolite.com).
  - 2. American Warming and Ventilating: [www.awv.com](http://www.awv.com).
  - 3. Construction Specialties, Inc: [www.c-sgroup.com](http://www.c-sgroup.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 LOUVERS**

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified under AMCA 511.
  - 1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.

2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
- B. Stationary Louvers: Horizontal blade, extruded aluminum construction, with intermediate mullions matching frame as required for support.
  1. Free Area: as required by mechanical system, minimum.
  2. Blades: Drainable.
  3. Frame: 4 inches deep, channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
  4. Metal Thickness: Frame 0.081 inch; blades 0.081 inch.
  5. Finish: Fluoropolymer coating, finished after fabrication.
  6. Color: As selected from manufacturer's standard colors.

## **2.03 MATERIALS**

- A. Extruded Aluminum: ASTM B221 (ASTM B221M),.
- B. Polyvinylidene Fluoride Coating: Minimum 70 percent Kynar 500/Hylar 500 resin, two coat finish, complying with AAMA 2604.

## **2.04 ACCESSORIES**

- A. Blank-Off Panels: Same material as louver, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
- B. Fasteners and Anchors: Galvanized steel.
- C. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

### **3.02 INSTALLATION**

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louver frames in openings with concealed fasteners.
- E. Install perimeter sealant and backing rod in accordance with Section 07 90 05.
- F. Coordinate with installation of mechanical ductwork.

### **3.03 ADJUSTING**

- A. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

### **3.04 CLEANING**

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

## **END OF SECTION**

**SECTION 09 21 16**  
**GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Performance criteria for gypsum board assemblies.
- B. Wood stud wall framing.
- C. Wood ceiling framing.
- D. Insulation.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Building framing and sheathing.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- D. Section 07 92 00 - Joint Sealers: Acoustic sealant.

**1.03 REFERENCE STANDARDS**

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002 (Reapproved 2007).
- B. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2011.
- C. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.
- D. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2010a.
- E. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets; 2008b.
- F. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2011.
- G. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- H. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2010.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on gypsum board, accessories, and joint finishing system.

**1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 3 years of experience.

## **PART 2 PRODUCTS**

### **2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
  - 1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL Fire Resistance Directory.

### **2.02 BOARD MATERIALS**

- A. Manufacturers - Gypsum-Based Board:
  - 1. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 2. Georgia-Pacific Gypsum: [www.gpgypsum.com](http://www.gpgypsum.com).
  - 3. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  - 4. USG Corporation: [www.usg.com](http://www.usg.com).
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard below 4 feet AFF: Basis of Design - GOLD BOND, HI-IMPACT XP Gypsum Board as manufactured by National Gypsum. Sizes to minimize joints in place; ends square cut.
  - 1. Regular Type:
    - a. Application: Use for vertical surfaces, unless otherwise indicated.
    - b. Thickness: 5/8 inch.
    - c. Edges: Tapered.
- C. Gypsum Wallboard above 4 feet AFF: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; tapered edges, ends square cut.
  - 1. Application: Use for vertical surfaces above 4 feet AFF, unless otherwise indicated.
  - 2. Thickness:
    - a. Vertical Surfaces: 5/8 inch.
  - 3. Mold-Resistant Paper-Faced Products:
    - a. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
    - b. Georgia-Pacific Gypsum; ToughRock Mold-Guard and ToughRock Mold-Guard Type X Gypsum Wallboard.
    - c. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
    - d. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
    - e. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Backing Board For Wet Areas: One of the following products:
  - 1. Application: Surfaces behind tile in wet areas including - as indicated on the drawings.
  - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  - 3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    - a. Thickness: 1/2 inch.
    - b. Products:
      - 1) National Gypsum Company; PermaBase Brand Cement Board.
      - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- E. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Ceilings, unless otherwise indicated.
  - 2. Thickness: 1/2 inch.
  - 3. Edges: Tapered.

- F. Gypsum Wallboard Fire Rated: Basis of Design: Gold Bond Type e<sup>2</sup> XP and Fire Shield as manufactured by National Gypsum to meet the requirements of the UL Assembly indicated on the drawings. Sizes to minimize joints in place; ends square cut.
  - 1. Regular Type:
    - a. Application: Use for vertical surfaces, unless otherwise indicated.
    - b. Thickness: 5/8 inch.
    - c. Edges: Tapered.

## **2.03 ACCESSORIES**

- A. Finishing Accessories: ASTM C1047, galvanized steel, unless otherwise indicated.
  - 1. Types: As detailed or required for finished appearance.
- B. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
  - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners.
  - 2. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
  - 3. Ready-mixed vinyl-based joint compound.
- C. Screws: ASTM C 1002; self-piercing tapping type.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 FRAMING INSTALLATION**

- A. Wood Framing: Install in accordance with manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as permitted by standard.
  - 1. Level ceiling system to a tolerance of 1/1200.
  - 2. Laterally brace entire suspension system.
- C. Studs: Space studs as permitted by standard.
- D. Blocking: Install wood blocking for support of:
  - 1. Framed openings.
  - 2. Wall mounted cabinets.
  - 3. Toilet accessories.
  - 4. Wall mounted door hardware.

### **3.03 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Place one bead continuously on substrate before installation of perimeter framing members.

### **3.04 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

### **3.05 JOINT TREATMENT**

- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:



1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  1. Feather coats of joint compound so that camber is maximum 1/32 inch.

### **3.06 TOLERANCES**

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

**END OF SECTION**

**SECTION 09 91 13  
EXTERIOR PAINTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Steel and iron.
  - 2. Galvanized metal.

**1.3 DEFINITIONS**

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) 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.

## **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

## **1.6 QUALITY CONTROL**

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Owner or Owner's Representative will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Owner or Owner's Representative will designate items or areas required.
  2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Owner or Owner's Representative at no added cost to Owner.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner or Owner's Representative specifically approves such deviations in writing.
  4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

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

## **1.8 FIELD CONDITIONS**

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Benjamin Moore & Co.
  - 2. PPG Paints.
  - 3. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.

### **2.2 PAINT, GENERAL**

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Owner or Owner's Representative from manufacturer's full range.

### **2.3 SOURCE QUALITY CONTROL**

- A. The Contractor shall be responsible for all required Quality Control testing and inspection. All work is subject to additional specialty inspections and Quality Assurance testing and inspection by the Owner or Owner's Representative. Contractor shall cooperate and provide access to all materials and work and provide additional samples to the Owner's Representative upon request. All work found by the Owner's Representative not to be in conformance with these specifications must be satisfactorily remedied by the Contractor, at no additional cost to the Owner, as a condition to acceptance of the work.
- B. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Testing agency will perform tests for compliance with product requirements.
2. Owner or Owner's Representative may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

## **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 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.
- 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. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods

recommended in writing by paint manufacturer, but not less than the following:

1. SSPC-SP 2.
  2. SSPC-SP 3.
  3. SSPC-SP 7/NACE No. 4.
  4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

### **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.

- g. Tanks that do not have factory-applied final finishes.

### **3.4 FIELD QUALITY CONTROL**

- A. The Contractor shall be responsible for all required Quality Control testing and inspection. All work is subject to additional specialty inspections and Quality Assurance testing and inspection by the Owner or Owner's Representative. Contractor shall cooperate and provide access to all materials and work and provide additional samples to the Owner's Representative upon request. All work found by the Owner's Representative not to be in conformance with these specifications must be satisfactorily remedied by the Contractor, at no additional cost to the Owner, as a condition to acceptance of the work.
- B. Dry Film Thickness Testing: Contractor shall engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### **3.5 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 Owner, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### **3.6 EXTERIOR PAINTING SCHEDULE**

- A. Steel and Iron Substrates:
  - 1. Alkyd System MPI EXT 5.1D:
    - a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
      - 1) Sherwin Williams; (Protective and Marine) Steel Spec Universal Metal Primer: B50WV8430.
    - b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.

- c. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.
  - 1) Sherwin Williams; (Protective and Marine) DMT Alkyd Semi-Gloss: B55W00101.

B. Galvanized-Metal Substrates:

1. Latex System MPI EXT 5.3H:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
  - 1) Sherwin Williams; (Pro Industrial) Pro-Cryl Universal Primer: B66W310.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.
  - Sherwin Williams; (A-100) Exterior latex
  - Gloss: A08W00151/A08WQ0151.

**END OF SECTION**



**SECTION 09 91 23  
INTERIOR PAINTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
1. Concrete masonry units (CMUs).
  2. Steel and iron.
  3. Galvanized metal.
  4. Gypsum board.
- B. Related Requirements:
1. Section 05 12 00 "Structural Steel Framing" for shop priming structural steel.
  2. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.

**1.3 DEFINITIONS**

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- 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 (200 mm) 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.

#### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### **1.6 QUALITY CONTROL**

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Owner will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9sq. m).
    - b. Other Items: Owner will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockup of additional colors selected by Owner at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations

- in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

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

## **1.8 FIELD CONDITIONS**

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Benjamin Moore & Co.
  2. PPG Paints.
  3. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

### **2.2 PAINT, GENERAL**

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Owner or Owner's Representative from manufacturer's full range.

## **2.3 SOURCE QUALITY CONTROL**

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
  - 1. Contractor will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner or Owner's Representative may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. 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 2.
  - 2. SSPC-SP 3.
  - 3. SSPC-SP 7/NACE No. 4.
  - 4. SSPC-SP 11.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas whereshop 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 sharplines 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.
  - 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 Owner.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### **3.4 FIELD QUALITY CONTROL**

- A. The Contractor shall be responsible for all required Quality Control testing and inspection. All work is subject to additional specialty inspections and Quality Assurance testing and inspection by the Owner or Owner's Representative. Contractor shall cooperate and provide access to all materials and work and provide additional samples to the Owner's Representative upon request. All work found by the Owner's Representative not to be in conformance with these specifications must be satisfactorily remedied by the Contractor, at no additional cost to the Owner, as a condition to acceptance of the work.
  1. Contractor shall touch up and restore painted surfaces damaged by testing.
  2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### **3.5 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 Owner, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### **3.6 INTERIOR PAINTING SCHEDULE**

#### **A. CMU Substrates:**

- 1. High-Performance Architectural Latex System MPI INT 4.2D:
  - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
    - 1) Sherwin Williams; (Pro Industrial) Heavy Duty Block Filler: B42W00150.
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural (MPI GlossLevel 3), MPI #139.
    - 1) Sherwin Williams; (ProMar 200 HP Zero VOC) Interior Acrylic Eg-Shel: B20W01951.

#### **B. Steel Substrates:**

- 1. High-Performance Architectural Latex System MPI INT 5.1R:
  - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
    - 1) Sherwin Williams; (Protective & Marine) Kem Bond HS Universal Alkyd Primer: B50WZ0004.
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural (MPI GlossLevel 3), MPI #139.
    - 1) Sherwin Williams; (ProMar 200 HP Zero VOC) Interior Acrylic Eg-Shel: B20W01951.

#### **C. Galvanized-Metal Substrates:**

- 1. High-Performance Architectural Latex System MPI INT 5.3M:
  - a. Prime Coat: Primer, galvanized, water based, MPI #134.

- 1) Sherwin Williams; (Protective & Marine) DTM Acrylic Primer/Finish: B66W1.
- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- c. Topcoat: Latex, interior, high performance architectural, semi-gloss(MPI Gloss Level 5), MPI #141.
- 1) Sherwin Williams; (Pro Industrial) Acrylic Semi-Gloss Coating: B66W00651.

D. Gypsum Board Substrates:

1. High-Performance Architectural Latex System MPI INT 9.2B:
  - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
    - 1) Sherwin Williams; (ProMar 200 Zero) Interior Latex Primer:B28W02600/BW8WQ2600.
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural (MPI GlossLevel 3), MPI #139.
    - 1) Sherwin Williams; (ProMar 200 HP Zero VOC) Interior Acrylic Eg-Shel: B20W01951.

**END OF SECTION**



**10 14 23  
PANEL SIGNAGE**

**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. Panel signs.

**1.3 DEFINITIONS**

- A. Accessible: In accordance with the accessibility standard.
- B. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

**1.4 COORDINATION**

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel 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.
  - 4. Show locations of electrical service connections.
  - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
  - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with

the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
  2. Exposed Accessories: Full-size Sample of each accessory type.
- E. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and manufacturer.
- B. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
- C. Sample Warranty: For special warranty.

## **1.7 CLOSEOUT SUBMITTALS**

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

## **1.8 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. Variable Component Materials: 12 replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
  2. Tools: One set of specialty tools for assembling signs and replacing variable sign components.

## **1.9 QUALITY CONTROL**

- A. Installer Qualifications: Manufacturer of products.

## **1.10 FIELD CONDITIONS**

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

## **1.11 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Deterioration of finishes beyond normal weathering.
  - b. Deterioration of embedded graphic image.
  - c. Separation or delamination of sheet materials and components.
2. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
  1. Uniform Wind Load: As indicated on the Structural Drawings.
  2. Concentrated Horizontal Load: As indicated on the Structural Drawings.
  3. Other Design Load: As indicated on the Structural Drawings.
  4. Uniform and concentrated loads need not be assumed to act concurrently.
- B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
  1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- C. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### **2.2 PANEL SIGNS**

- A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. APCO Graphics, Inc.
    - b. ASI Sign Systems, Inc.
    - c. Inpro Corporation.
  2. Solid-Sheet Sign, Returns, and Back: Aluminum sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:
    - a. Thickness: Manufacturer's standard for size of sign.
    - b. Surface-Applied, Flat Graphics: Applied vinyl film or baked enamel or powder

coat paint.

3. Sign-Panel Perimeter: Finish edges smooth.
  - a. Edge Condition: Square cut.
  - b. Corner Condition in Elevation: Square.
4. Mounting: Manufacturer's standard method for substrates indicated.
5. Surface Finish and Applied Graphics:
  - a. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as selected by Owner or Owner's Representative from manufacturer's full range.
  - b. Painted Finish and Graphics: Manufacturer's standard, factory-applied exterior-grade sign paint, in color as selected by Owner or Owner's Representative from manufacturer's full range.
  - c. Overcoat: Manufacturer's standard baked-on clear coating.
6. Text and Typeface: Typeface as selected by Owner or Owner's Representative from manufacturer's full range and variable content as scheduled.
7. Flatness Tolerance: Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner.

## **2.3 PANEL-SIGN MATERIALS**

- A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure- sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.
- D. 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 unless otherwise indicated:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
  3. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back

- of sign material or screwed into back of sign assembly unless otherwise indicated.
    - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
    - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
  - 4. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.
- B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
  - 1. Uses: Securing signs with imposed loads to structure.
  - 2. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor.
  - 3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 5. Internally brace signs for stability, to meet structural performance loading without oil-

- canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.
1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
  2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
  3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
  4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
- C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.
- F. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.

## **2.6 GENERAL FINISH REQUIREMENTS**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

## **2.7 ALUMINUM FINISHES**

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.
- D. Verify that electrical service is correctly sized and located to accommodate signs.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 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.
  - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Accessible Signage: Install in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install

washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
  - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
  - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
5. 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.
6. Shim-Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using method specified above.

### **3.3 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 or Owner's Representative.

### **END OF SECTION 10 14 23**



**SECTION 10 14 23.16**  
**ROOM IDENTIFICATION PANEL SIGNAGE**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes room-identification signs that are directly attached to the building.

**1.3 DEFINITIONS**

- A. Accessible: In accordance with the accessibility standard.

**1.4 COORDINATION**

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

**1.5 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 Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
  - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Room-Identification Signs: Full-size Sample.
  - 2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in

- Samples above.
- 3. Exposed Accessories: Full-size Sample of each accessory type.
- 4. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

#### **1.7 CLOSEOUT SUBMITTALS**

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

#### **1.8 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. Variable Component Materials: 12 replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
  - 2. Tools: One set of specialty tools for assembling signs and replacing variable sign components.

#### **1.9 QUALITY CONTROL**

- A. Installer Qualifications: Manufacturer of products.

#### **1.10 FIELD CONDITIONS**

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

#### **1.11 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

### **2.2 ROOM-IDENTIFICATION SIGNS**

- A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. APCO Graphics, Inc.
    - b. ASI Sign Systems, Inc.
    - c. Inpro Corporation.
    - d. Poblocki Sign Company, LLC.
  - 2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    - b. Surface-Applied Graphics: Applied vinyl film.
    - c. Subsurface Graphics: Slide-in changeable insert.
    - d. Color(s): As selected by Owner or Owner's Representative from manufacturer's full range.
  - 3. Sign-Panel Perimeter: Finish edges smooth.
    - a. Edge Condition: Square cut.
    - b. Corner Condition in Elevation: Square.
  - 4. Mounting: Manufacturer's standard method for substrates indicated.
  - 5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Owner or Owner's Representative from manufacturer's full range and variable content as scheduled Finish raised characters to contrast with background color, and finish Braille to match background color.

### **2.3 SIGN MATERIALS**

- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.
- C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by

manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

## **2.4 ACCESSORIES**

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Use concealed fasteners and anchors unless indicated to be exposed.
  - 2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
  - 3. 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 or one-way-head slots unless otherwise indicated.
  - 4. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
- D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.
- E. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

## **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.
  - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
  - 1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner. Furnish two blank inserts for each sign for Owner's use.
  - 2. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. Subsequent changeable sign panels are by Owner.

## **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. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive

- fully sets.
- b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
  2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
  3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
  4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
  5. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch (6.35 mm) away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
  6. Magnetic 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.

### **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 or Owner's Representative.

### **END OF SECTION**

**SECTION 10 28 00**  
**TOILET, BATH, AND LAUNDRY ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Accessories for toilet rooms.
- B. Grab bars.

**1.02 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with the placement of reinforcement of toilet partitions to receive anchor attachments.

**1.03 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

**2.02 MANUFACTURERS**

- A. Products listed are made by Bobrick.
- B. Other Acceptable Manufacturers:
  - 1. A & J Washroom Accessories Inc: [www.ajwashroom.com](http://www.ajwashroom.com).
  - 2. American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com).
  - 3. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
  - 4. Substitutions: Section 01 60 00 - Product Requirements.
- C. All items of each type to be made by the same manufacturer to the fullest extent possible.

**2.03 MATERIALS**

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
  - 1. Grind welded joints smooth.
  - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Provide 5 keys for each accessory to Owner; master key all lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269, Type 304 or 316.
- E. Mirror Glass: Framed Float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.
- G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

**2.04 FINISHES**

- A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.

- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.

### **3.02 PREPARATION**

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

### **3.03 INSTALLATION**

- A. Install accessories in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings

### **3.04 SCHEDULE**

- A. Refer to Toilet Accessory Schedule on the drawings.

**END OF SECTION**



**SECTION 22 05 17**  
**SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.
  - 4. Silicone sealants.

**1.02 ACTION SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.01 SLEEVES**

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

**2.02 SLEEVE-SEAL SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. GPT; an EnPro Industries company.
  - 3. Metraflex Company (The).
- B. Description:
  - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 2. Designed to form a hydrostatic seal of 20 psig minimum.
  - 3. Sealing Elements: EPDM-rubber or High-Temperature Silicone with interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 4. Pressure Plates: Composite plastic or Stainless steel, Type 316.
  - 5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 or Stainless steel, Type 316 of length required to secure pressure plates to sealing elements.

**2.03 GROUT**

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## **2.04 SILICONE SEALANTS**

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Sherwin-Williams Company (The).
    - c. The Dow Chemical Company.

## **PART 3 - EXECUTION**

### **3.01 SLEEVE INSTALLATION**

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide required annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

### **3.02 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### **3.03 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.04 SLEEVE AND SLEEVE-SEAL SCHEDULE**

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron or steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves.
  2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron or steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron or steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.
  4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves.
  5. Interior Partitions:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

**END OF SECTION**

**SECTION 22 05 18**  
**ESCUTCHEONS FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

**1.02 ACTION SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. BrassCraft Manufacturing Co.; a Masco company.
  - 2. Dearborn Brass.
  - 3. Keeney Manufacturing Company (The).

**2.02 ESCUTCHEONS**

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

**2.03 FLOOR PLATES**

- A. Split Floor Plates: Cast brass with concealed hinge.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece cast brass or split-casting brass with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
    - d. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
  - f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
  - h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
  - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
    - 1. New Piping: Split floor plate.

### **3.02 FIELD QUALITY CONTROL**

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

**END OF SECTION**

**SECTION 22 05 19**  
**METERS AND GAGES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
1. Bimetallic-actuated thermometers.
  2. Liquid-in-glass thermometers.
  3. Thermowells.
  4. Dial-type pressure gages.
  5. Gage attachments.

**1.03 ACTION SUBMITTALS**

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

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

**PART 2 - PRODUCTS**

**2.01 BIMETALLIC-ACTUATED THERMOMETERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ashcroft Inc.
  2. Palmer Wahl Instrumentation Group.
  3. Weiss Instruments, Inc.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle rigid, back and rigid, bottom, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

## 2.02 LIQUID-IN-GLASS THERMOMETERS

### A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Cast aluminum; 6-inch nominal size.
3. Case Form: Back angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: Glass or plastic.
7. Stem: Aluminum or brass and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
8. Connector: 3/4 inch, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.03 THERMOWELLS

### A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

### B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.04 PRESSURE GAGES

### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ashcroft Inc.
  - b. Palmer Wahl Instrumentation Group.
  - c. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Liquid-filled Sealed Solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## **2.05 GAGE ATTACHMENTS**

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.
- K. Install pressure gages in the following locations:
  - 1. Building water service entrance into building.
  - 2. Suction and discharge of each domestic water pump.
- L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- M. Adjust faces of meters and gages to proper angle for best visibility.

### **3.02 THERMOMETER SCHEDULE**

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
  - 1. Liquid-filled Sealed, bimetallic-actuated type.
  - 2. Metal case, compact-style, liquid-in-glass type.
- B. Thermometer stems shall be of length to match thermowell insertion length.

### **3.03 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.
- C. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.

### **3.04 PRESSURE-GAGE SCHEDULE**

- A. Pressure gages at discharge of each water service into building shall be the following:
  - 1. Liquid-filled Sealed Solid-front, pressure-relief, direct-mounted, metal case.
- B. Pressure gages at suction and discharge of each domestic water pump shall be the following:
  - 1. Liquid-filled Sealed Solid-front, pressure-relief, direct-mounted, metal case.



### **3.05 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Water Service Piping: 0 to 160 psi.
- B. Scale Range for Domestic Water Piping: 0 to 100 psi.
- C. Scale Range for Domestic Water Piping: 0 to 160 psi.

**END OF SECTION**

**SECTION 22 05 23.12**  
**BALL VALVES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
1. Brass ball valves.
  2. Bronze ball valves.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of valve.
1. Certification that products comply with NSF 61 and NSF 372.

**PART 2 - PRODUCTS**

**2.01 GENERAL REQUIREMENTS FOR VALVES**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
  2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  3. ASME B16.18 for solder-joint connections.
  4. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
  2. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
1. Include 2-inch stem extensions.
  2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  3. Memory stops that are fully adjustable after insulation is applied.

**2.02 BRASS BALL VALVES**

- A. Brass Ball Valves, One-Piece:
1. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 400 psig.
    - c. Body Design: One piece.
    - d. Body Material: Forged brass or bronze.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.

- g. Stem: Brass or stainless steel.
  - h. Ball: Chrome-plated brass or stainless steel.
  - i. Port: Reduced.
  - j. Adjustable packing gland.
- B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:
- 1. Description:
    - a. Standard: MSS SP-110 or MSS SP-145.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Forged brass.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Full.
    - j. Adjustable packing gland.
- C. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:
- 1. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Forged brass.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Regular.
    - j. Adjustable packing gland.

## 2.03 BRONZE BALL VALVES

- A. Bronze Ball Valves, One-Piece:
- 1. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 400 psig.
    - c. Body Design: One piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded.
    - f. Seats: PTFE.
    - g. Stem: Bronze.
    - h. Ball: Chrome-plated brass.
    - i. Port: Reduced.
    - j. Adjustable packing gland.
- B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:
- 1. Description:
    - a. Standard: MSS SP-110 or MSS-145.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Bronze or brass.
    - h. Ball: Chrome-plated brass.

- i. Port: Full.
  - j. Adjustable packing gland.
- C. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:
  - 1. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded.
    - f. Seats: PTFE.
    - g. Stem: Bronze or brass.
    - h. Ball: Chrome-plated brass.
    - i. Port: Regular.
    - j. Adjustable packing gland.

## **PART 3 - EXECUTION**

### **3.01 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

### **3.02 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

### **3.03 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE**

- A. Pipe NPS 2 and Smaller:
  - 1. Brass ball valve, one piece. Provide with threaded or solder-joint ends.
  - 2. Bronze ball valve, one piece with bronze trim. Provide with threaded or solder-joint ends.
  - 3. Brass ball valves, two-piece with full port and brass trim. Provide with threaded or solder-joint ends.
  - 4. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with threaded or solder-joint ends.

## **END OF SECTION**

**SECTION 22 05 23.14**  
**CHECK VALVES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Bronze swing check valves.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 and NSF 372.

**PART 2 - PRODUCTS**

**2.01 GENERAL REQUIREMENTS FOR VALVES**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 4. ASME B16.18 for solder joint.
  - 5. ASME B31.9 for building services piping valves.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.

**2.02 BRONZE SWING CHECK VALVES**

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
  - 1. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B62, bronze.
    - e. Ends: Threaded or soldered. See valve schedule articles.
    - f. Disc: Bronze.
- B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:
  - 1. Description:
    - a. Standard: MSS SP-80, Type 4.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B62, bronze.

- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: PTFE.

## **PART 3 - EXECUTION**

### **3.01 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

### **3.02 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### **3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
  - 1. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; metal-seat or resilient-seat check valves.
    - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered-ends.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
  - 3. For Copper Tubing, NPS 5 and Larger: Flanged.
  - 4. For Steel Piping, NPS 2 and Smaller: Threaded.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
  - 6. For Steel Piping, NPS 5 and Larger: Flanged.

### **3.04 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE**

- A. Pipe NPS 2 1/2" and Smaller:
  - 1. Bronze swing check valves bronze disc, Class 125, with soldered or threaded end connections.

**END OF SECTION**

**SECTION 22 05 29**  
**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Thermal hanger-shield inserts.
  - 4. Fastener systems.
  - 5. Pipe-positioning systems.
  - 6. Equipment supports.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.03 QUALITY ASSURANCE**

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

**2.02 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## **2.03 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## **2.04 FASTENER SYSTEMS**

- A. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. B-line, an Eaton business.
    - b. Hilti, Inc.
    - c. MKT Fastening, LLC.
  2. Indoor Applications: Zinc-coated steel.
  3. Outdoor Applications: Stainless steel.

## **2.05 PIPE-POSITIONING SYSTEMS**

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## **2.06 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

## **2.07 MATERIALS**

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.



## **PART 3 - EXECUTION**

### **3.01 APPLICATION**

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

### **3.02 HANGER AND SUPPORT INSTALLATION**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fastener System Installation:
  - 1. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### **3.03 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.04 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

### **3.05 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.06 PAINTING**

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.07 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use thermal hanger-shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
  - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  - 6. C-Clamps (MSS Type 23): For structural shapes.
  - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

- 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- 12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
- M. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION**

**SECTION 22 05 53**  
**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.

**1.02 ACTION SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.01 EQUIPMENT LABELS**

- A. Plastic Labels for Equipment:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Craftmark Pipe Markers.
    - c. Seton Identification Products; a Brady Corporation company.
  - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 3. Letter Color: Black.
  - 4. Background Color: White.
  - 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  - 8. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

**2.02 WARNING SIGNS AND LABELS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Craftmark Pipe Markers.

3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: White.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

### 2.03 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Brady Corporation.
  2. Craftmark Pipe Markers.
  3. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: Size letters according to ASME A13.1 for piping.

## PART 3 - EXECUTION

### 3.01 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.02 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
1. Low-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  2. High-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  3. Domestic Water Piping
    - a. Background: Safety green.
    - b. Letter Colors: White.
  4. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Safety black.
    - b. Letter Color: White.

**END OF SECTION**

**SECTION 22 05 93**  
**TESTING, ADJUSTING, AND BALANCING FOR PLUMBING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. TAB of domestic water system.
  - 2. TAB of plumbing equipment:
    - a. Pipe-leakage test verification.

**1.02 DEFINITIONS**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

**1.03 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB reports.
- C. Sample report forms.
- D. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

**1.04 QUALITY ASSURANCE**

- A. TAB Specialists Qualifications, Certified by AABC:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- E. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.



## **1.05 FIELD CONDITIONS**

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## **PART 2 - EXECUTION**

### **2.01 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine equipment performance data, including pump curves.
  - 1. Relate performance data to Project conditions and requirements.
- E. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- F. Examine test reports specified in individual system and equipment Sections.
- G. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- H. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- I. Examine system pumps to ensure absence of entrained air in the suction piping.
- J. Examine operating safety interlocks and controls on plumbing equipment.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **2.02 PREPARATION**

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Domestic Water System:
    - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
    - b. Water heaters are installed and functioning.
    - c. Piping is complete and all points of outlet are installed.
    - d. Water treatment is complete.
    - e. Systems are flushed, filled, and air purged.
    - f. Strainers are clean.
    - g. Control valves are functioning in accordance with the sequence of operation.
    - h. Shutoff and balance valves are 100 percent open.
    - i. Suitable access to balancing devices and equipment is provided.

### **2.03 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 22 07 19 "Plumbing Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in units.

### **2.04 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT**

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Domestic water heaters.

### **2.05 PROCEDURES FOR DOMESTIC WATER SYSTEMS**

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
  - 1. Check expansion tank for proper setting.
  - 2. Check water heater for proper discharge temperature setting.
  - 3. Check remotest point of outlet for adequate pressure.
  - 4. Check flow-control valves for proper position.
  - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  - 6. Verify that motor controllers are equipped with properly sized thermal protection.
  - 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

### **2.06 PROCEDURES FOR WATER HEATERS**

- A. Electric Water Heaters:
  - 1. Measure and record entering- and leaving-water temperatures.
  - 2. Measure and record water flow.
  - 3. Measure and record pressure drop.
  - 4. Record relief valve(s) pressure setting.
  - 5. Capacity: Calculate in Btu/h of heating output.
  - 6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

## 2.07 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
  - 1. Domestic Water Flow Rate: Plus or minus 10 percent.

## 2.08 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Manufacturers' test data.
  - 2. Field test reports prepared by system and equipment installers.
  - 3. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents, including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Notes to explain why certain final data in the body of reports vary from indicated values.
  - 14. Test conditions for pump performance forms, including the following:
    - a. Variable-frequency controller settings for variable-flow hydronic systems.
    - b. Settings for pressure controller(s).
    - c. Other system operating conditions that affect performance.
- D. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
  - 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Model number and unit size.
    - d. Manufacturer's serial number.
    - e. Output capacity in Btu/h.
    - f. Number of stages.
    - g. Connected volts, phase, and hertz.
    - h. Rated amperage.
  - 2. Test Data (Indicated and Actual Values):
    - a. Heat output in Btu/h.
    - b. Entering-water temperature in deg F.

- c. Leaving-water temperature in deg F.
  - d. High-temperature-limit setting in deg F.
  - e. Operating set point in deg F.
  - f. Voltage at each connection.
  - g. Amperage for each phase.
- E. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

## **2.09 ADDITIONAL TESTS**

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

**END OF SECTION**

**SECTION 22 07 19  
PLUMBING PIPING INSULATION**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Supplies and drains for handicap-accessible lavatories and sinks.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at pipe expansion joints for each type of insulation.
  - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 5. Detail application of field-applied jackets.
  - 6. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated.

**1.03 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

**1.04 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.05 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Pittsburgh Corning Corporation.
  - 2. Preformed Pipe Insulation: Type II, Class 1, without jacket.
  - 3. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ jacket.
  - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
- H. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning.
  - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
  - 3. 850 deg F.
  - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
  - 1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  - 2. Wet Flash Point: Below 0 deg F.
  - 3. Service Temperature Range: 40 to 200 deg F.
  - 4. Color: Black.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.

## 2.03 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Knauf Insulation.
  - 2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  - 3. Service Temperature Range: 0 to plus 180 deg F.
  - 4. Color: White.

## 2.04 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
  - 1. Permanently flexible, elastomeric sealant.
  - 2. Service Temperature Range: Minus 58 to plus 176 deg F.
  - 3. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
  - 1. Fire- and water-resistant, flexible, elastomeric sealant.
  - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 3. Color: Aluminum.
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
  - 1. Fire- and water-resistant, flexible, elastomeric sealant.
  - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 3. Color: White.

## 2.05 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

## **2.06 FIELD-APPLIED FABRIC-REINFORCING MESH**

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

## **2.07 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Adhesive: As recommended by jacket material manufacturer.
  2. Color: White.
  3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
  1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

## **2.08 TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.



1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## **2.09 SECUREMENTS**

- A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
  2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

## **2.10 PROTECTIVE SHIELDING GUARDS**

- A. Protective Shielding Pipe Covers,:
1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures,:
1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### **3.02 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

### **3.03 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

### **3.04 GENERAL PIPE INSULATION INSTALLATION**

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape

insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.05 INSTALLATION OF CELLULAR-GLASS INSULATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### **3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
  - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.07 INSTALLATION OF MINERAL-FIBER INSULATION**

- A. Insulation Installation on Straight Pipes and Tubes:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
  - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  - 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
  - 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install preformed pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
  - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.

### **3.08 INSTALLATION OF POLYOLEFIN INSULATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.09 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### **3.10 FINISHES**

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

### **3.11 FIELD QUALITY CONTROL**

- A. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Owner or Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.12 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### **3.13 INDOOR PIPING INSULATION SCHEDULE**

- A. Domestic Cold Water:
1. NPS 1 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  2. NPS 1-1/4 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot Water:
1. NPS 1-1/4 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.



2. NPS 1-1/2 and Larger: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

### **3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE**

- A. Domestic Water Piping:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- B. Domestic Hot Water:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

### **3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  1. PVC: 20 mils thick.
- D. Piping, Exposed:
  1. PVC: 20 mils thick.

### **3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
  1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

### **3.17 UNDERGROUND, FIELD-APPLIED INSULATION JACKET**

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

**END OF SECTION**

## **SECTION 22 11 16 DOMESTIC WATER PIPING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Copper tube and fittings – domestic water.
  - 2. CPVC piping - domestic water.
  - 3. PEX tube and fittings - domestic water.
  - 4. PVC pipe and fittings - domestic water.
  - 5. Piping joining materials.
  - 6. Transition fittings.
  - 7. Dielectric fittings.

#### **1.02 QUALITY ASSURANCE**

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

### **PART 2 - PRODUCTS**

#### **2.01 PERFORMANCE REQUIREMENTS**

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

#### **2.02 PIPING MATERIALS**

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

#### **2.03 COPPER TUBE AND FITTINGS – DOMESTIC WATER**

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.
- G. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
  - 1. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.

2. Minimum 200-psig working-pressure rating at 250 deg F.

#### **2.04 CPVC PIPING - DOMESTIC WATER**

- A. Manufacturer:
  1. Corzan
  2. Flowguard Gold
- B. CPVC Pipe: ASTM F441/F441M, with wall thickness as indicated in "Piping Applications" Article.
  1. CPVC Socket Fittings: ASTM F438 for Schedule 40 and ASTM F439 for Schedule 80.
  2. CPVC Threaded Fittings: ASTM F437, Schedule 80.
- C. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.
- D. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.

#### **2.05 PEX TUBE AND FITTINGS - DOMESTIC WATER**

- A. PEX Tube - Domestic Water:
  1. Manufacturer: Uponor AquaPEX pipe
  2. Tube Material: PEX plastic in accordance with ASTM F876 and ASTM F877.
- B. PEX Tube Fittings - Domestic Water:
  1. Manufacturer: Uponor ProPEX fittings
  2. Fittings: ASTM F1807, metal insert and copper crimp rings ASTM F1960, cold expansion fittings and reinforcing rings.
  3. Push-Fit Fittings: ASSE 1061, push-fit fittings.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

#### **2.06 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials:
  1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.
- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

#### **2.07 TRANSITION FITTINGS**

- A. General Requirements:
  1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.

- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.
- D. Plastic-to-Metal Transition Fittings - Domestic Water:
  - 1. Description:
    - a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
    - b. One end with threaded brass insert and one solvent-cement-socket end.
- E. Plastic-to-Metal Transition Unions - Domestic Water:
  - 1. Description:
    - a. CPVC four-part union.
    - b. Brass or stainless steel threaded end.
    - c. Solvent-cement-joint plastic end.
    - d. Rubber O-ring.
    - e. Union nut.

## **2.08 DIELECTRIC FITTINGS**

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Standard: ASSE 1079.
  - 2. Pressure Rating: 125 psig minimum at 180 deg F.
  - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Standard: ASSE 1079.
  - 2. Factory-fabricated, bolted, companion-flange assembly.
  - 3. Pressure Rating: 125 psig minimum at 180 deg F.
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  - 1. Nonconducting materials for field assembly of companion flanges.
  - 2. Pressure Rating: 150 psig.
  - 3. Gasket: Neoprene or phenolic.
  - 4. Bolt Sleeves: Phenolic or polyethylene.
  - 5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
  - 1. Standard: IAPMO PS 66.
  - 2. Electroplated steel nipple complying with ASTM F 1545.
  - 3. Pressure Rating and Temperature: 300 psig at 225 deg F.
  - 4. End Connections: Male threaded or grooved.
  - 5. Lining: Inert and noncorrosive, propylene.

## **PART 3 - EXECUTION**

### **3.01 EARTHWORK**

- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

### 3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."
- F. Install domestic water piping level and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install PEX tube with loop at each change of direction of more than 90 degrees.
- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### **3.03 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- H. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- J. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join in accordance with ASTM D2846/D2846M.
- K. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
- L. Joints for PEX Tubing, ASSE: Join in accordance with ASSE 1061 for push-fit fittings.
- M. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### **3.04 TRANSITION FITTING INSTALLATION**

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### **3.05 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### **3.06 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for copper and galvanized steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install vinyl-coated hangers for CPVC and PP pipe, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install vinyl-coated hangers for PEX tube, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of copper galvanized steel and to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of CPVC and PP-R/PP-RCT pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- H. Support vertical runs of PEX tube to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### **3.07 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### **3.08 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### **3.09 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
    - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
  - 2. Piping Tests:
    - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
    - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
    - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.10 ADJUSTING**

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.



6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### **3.11 CLEANING**

- A. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### **3.12 PIPING SCHEDULE**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
  1. Soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
  2. PVC, Schedule 40; socket fittings; and solvent-cemented joints.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
  1. Hard or soft copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed copper pressure-seal-joint fittings; and pressure-sealed joints.
  2. PVC, Schedule 40; socket fittings; and solvent-cemented joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and solder joints.
  2. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
  3. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
  4. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. NPS 1-1/2 and NPS 2 CPVC pipe with CPVC socket fittings may be used instead of tubing.
  5. PEX tube, NPS 1 and smaller.

- a. Fittings for PEX tube:
    - 1) ASTM F1807, metal insert and copper crimp rings.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.
  - 2. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
  - 3. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

**END OF SECTION**

**SECTION 22 11 19**  
**DOMESTIC WATER PIPING SPECIALTIES**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Temperature-actuated, water mixing valves.
  - 4. Strainers.
  - 5. Outlet boxes.
  - 6. Wall hydrants.
  - 7. Drain valves.
  - 8. Water-hammer arresters.
- B. Related Requirements:
  - 1. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  - 1. Include diagrams for power, signal, and control wiring.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**PART 2 - PRODUCTS**

**2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES**

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.
- B. Comply with NSF 372 for low lead.

**2.02 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

**2.03 VACUUM BREAKERS**

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Standard: ASSE 1001.
  - 2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
  - 3. Body: Bronze.

4. Inlet and Outlet Connections: Threaded.
  5. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
1. Standard: ASSE 1011.
  2. Body: Bronze, nonremovable, with manual drain.
  3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  4. Finish: Chrome or nickel plated.

## 2.04 BACKFLOW PREVENTERS

- A. Double-Check, Backflow-Prevention Assemblies:
1. Standard: ASSE 1015.
  2. Operation: Continuous-pressure applications unless otherwise indicated.
  3. Pressure Loss: 5 psig maximum, through middle third of flow range.
  4. Body: Bronze, cast silicon copper alloy or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
  5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  6. Configuration: Designed for horizontal, straight-through flow.
  7. Accessories:
    - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

## 2.05 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
1. Manufacturers: As indicated on drawings.
  2. Standard: ASSE 1017.
  3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
  5. Material: Bronze body with corrosion-resistant interior components.
  6. Connections: Threaded union inlets and outlet.
  7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  8. Valve Finish: Rough bronze.
  9. Piping Finish: Copper.
  10. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

## 2.06 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
  2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
  3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  4. Screen: Stainless steel with round perforations unless otherwise indicated.
  5. Perforation Size:
    - a. Strainers NPS 2 and Smaller: 0.020 inch.
    - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    - c. Strainers NPS 5 and Larger: 0.10 inch.
  6. Drain: Factory-installed, hose-end drain valve.

## **2.07 OUTLET BOXES**

### **A. Icemaker Outlet Boxes:**

1. Manufacturers: As indicated on drawings.
2. Mounting: Recessed.
3. Material and Finish: Plastic box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Accessory: Water hammer arrestor.
6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

## **2.08 WALL HYDRANTS**

### **A. Nonfreeze Wall Hydrants:**

1. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 1/2.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Chrome plated.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
11. Operating Keys(s): Two with each wall hydrant.

## **2.09 DRAIN VALVES**

### **A. Ball-Valve-Type, Hose-End Drain Valves:**

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## **2.10 WATER-HAMMER ARRESTERS**

### **A. Water-Hammer Arresters:**

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal bellows.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- C. Y-Pattern Strainers: For water, install on supply side of each solenoid valve and pump.
- D. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 00 "Rough Carpentry."

### **3.02 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

### **3.03 IDENTIFICATION**

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Double-check backflow prevention assemblies.
  - 2. Primary, thermostatic, water mixing valves.
  - 3. Manifold, thermostatic, water mixing-valve assemblies.
  - 4. Outlet boxes.
  - 5. Hose stations.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### **3.04 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.05 ADJUSTING**

- A. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

**END OF SECTION**

**SECTION 22 13 16  
SANITARY WASTE AND VENT PIPING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. PVC pipe and fittings.
  - 3. Specialty pipe fittings.

**1.02 ACTION SUBMITTALS**

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

**1.03 WARRANTY**

- A. Listed manufacturers to provide labeling and warranty of their respective products.

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

**2.02 PIPING MATERIALS**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

**2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Charlotte Pipe and Foundry Company.
  - 2. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings: ASTM A 74, Service class.
- C. Gaskets: ASTM C 564, rubber.
- D. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

**2.04 PVC PIPE AND FITTINGS**

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.



- D. Adhesive Primer: ASTM F 656.
- E. Solvent Cement: ASTM D 2564.

## **2.05 SPECIALTY PIPE FITTINGS**

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Shielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C 1460.
    - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.

## **PART 3 - EXECUTION**

### **3.01 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

### **3.02 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

- a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Install underground PVC piping according to ASTM D 2321.
- P. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.03 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

### **3.04 SPECIALTY PIPE FITTING INSTALLATION**

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

### **3.05 VALVE INSTALLATION**

- A. Comply with requirements in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.14 "Check Valves for Plumbing Piping" for general-duty valve installation requirements.
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sewage pump discharge.
  - 2. Install full-port ball valve for piping NPS 2 and smaller.
  - 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

### **3.06 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### **3.07 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Equipment: Connect waste piping as indicated.
  - a. Provide shutoff valve if indicated and union for each connection.
  - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
  1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### **3.08 IDENTIFICATION**

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### **3.09 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.

- c. Air pressure must remain constant without introducing additional air throughout period of inspection.
  - d. Inspect plumbing fixture connections for gas and water leaks.
- 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 6. Prepare reports for tests and required corrective action.

### **3.10 CLEANING AND PROTECTION**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### **3.11 PIPING SCHEDULE**

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
    - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
  - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
  - 3. Cast Iron Pipe and Fittings: ASTM A 74, Service class, Gaskets: ASTM C 564, rubber. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.
- G. Underground, soil and waste piping NPS 5 and larger shall be the following:
  - 1. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
  - 3. Cast Iron Pipe and Fittings: ASTM A 74, Service class, Gaskets: ASTM C 564, rubber. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

**END OF SECTION**

**SECTION 22 13 19**  
**SANITARY WASTE PIPING SPECIALTIES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.
- B. Related Requirements:
  - 1. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
  - 2. Section 07 72 00 "Roof Accessories" for preformed flashings.

**1.02 ACTION SUBMITTALS**

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

**1.03 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS**

**2.01 ASSEMBLY DESCRIPTIONS**

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

**2.02 CLEANOUTS**

- A. Cast-Iron Exposed Cleanouts:
  - 1. Standard: ASME A112.36.2M.
  - 2. Size: Same as connected drainage piping
  - 3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  - 4. Closure: Countersunk, plastic plug.
  - 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Exposed Floor Cleanouts:
  - 1. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule threaded, adjustable housing cleanout.
  - 2. Size: Same as connected branch.
  - 3. Type: Adjustable housing Cast-iron soil pipe with cast-iron ferrule Threaded, adjustable housing.
  - 4. Body or Ferrule: Cast iron.
  - 5. Clamping Device: Required.
  - 6. Outlet Connection: Inside calk Spigot.
  - 7. Closure: Plastic plug.
  - 8. Adjustable Housing Material: Cast iron with threads.
  - 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
  - 10. Frame and Cover Shape: Round.

11. Top-Loading Classification: Heavy Duty.
12. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

## **2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES**

- A. Open Drains:
  1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
  2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
  1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
  2. Size: Same as connected waste piping.
    - a. NPS 2: 4-inch-minimum water seal.
    - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.
- C. Floor-Drain, Inline Trap Seal:
  1. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
  2. Material: Polymer.
  3. Standard: Tested and certified in accordance with ASSE 1072.
  4. Listing: ICC-ES or IAPMO listed.
  5. Size: Same as floor drain outlet or strainer throat.
- D. Sleeve Flashing Device:
  1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
  2. Size: As required for close fit to riser or stack piping.
- E. Stack Flashing Fittings:
  1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
  2. Size: Same as connected stack vent or vent stack.
- F. Vent Caps:
  1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
  2. Size: Same as connected stack vent or vent stack.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install backwater valves in building drain piping.
  1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.

- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. Assemble open drain fittings and install with top of hub 2 inches above floor.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- F. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- G. Install vent caps on each vent pipe passing through roof.
- H. Install wood-blocking reinforcement for wall-mounting-type specialties.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### **3.02 PIPING CONNECTIONS**

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

### **3.03 LABELING AND IDENTIFYING**

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
  - 1. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### **3.04 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

### **END OF SECTION**



**SECTION 22 13 19.13  
SANITARY DRAINS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Floor drains.
  - 2. Floor sinks.

**1.02 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

**1.03 ACTION SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.01 DRAIN ASSEMBLIES**

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

**2.02 FLOOR DRAINS**

- A. Cast-Iron Floor Drains:
  - 1. Standard: ASME A112.6.3.
  - 2. Pattern: Floor drain.
  - 3. Body Material: Gray iron.
  - 4. Seepage Flange: Required.
  - 5. Outlet: Bottom.
  - 6. Backwater Valve: Not required.
  - 7. Coating on Interior and Exposed Exterior Surfaces: Not required.
  - 8. Sediment Bucket: Not required.
  - 9. Top or Strainer Material: Bronze.
  - 10. Top of Body and Strainer Finish: Rough bronze.

**2.03 FLOOR SINKS**

- A. Cast-Iron Floor Sinks:
  - 1. Standard: ASME A112.6.7.
  - 2. Pattern: Floor drain.
  - 3. Body Material: Cast iron.

4. Outlet: Bottom, no-hub, connection.
5. Coating on Interior Surfaces: Not required.
6. Sediment Bucket: Not required.
7. Top Grate Material: Cast iron.
8. Top of Body and Grate Finish: Nickel bronze.
9. Top Loading Classification: No traffic.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  1. Position floor drains for easy access and maintenance.
  2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
  3. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
    - a. Maintain integrity of waterproof membranes where penetrated.
  5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

### **3.02 CONNECTIONS**

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 22 13 19 "Sanitary Waste Piping Specialties" for miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.

### **3.03 LABELING AND IDENTIFYING**

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### **3.04 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

## **END OF SECTION**

**SECTION 22 33 00**  
**ELECTRIC, DOMESTIC-WATER HEATERS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

A. Section Includes:

1. Commercial, electric, storage, domestic-water heaters.
2. Commercial, light-duty, storage, electric, domestic-water heaters.
3. Domestic-water heater accessories.

**1.02 ACTION SUBMITTALS**

A. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

**1.03 CLOSEOUT SUBMITTALS**

A. Operation and maintenance data.

**1.04 COORDINATION**

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

**1.05 WARRANTY**

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.
  - a. Commercial, Electric, Storage, Domestic-Water Heaters:
    - 1) Storage Tank: Three years.
    - 2) Controls and Other Components: Three years.
  - b. Commercial, Light Duty, Storage, Electric, Domestic-Water Heaters:
    - 1) Storage Tank: Three years.
    - 2) Controls and Other Components: Three years.
  - c. Expansion Tanks: Five years.

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

## 2.02 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

### A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: As indicated on drawings.
2. Standard: UL 1453
3. Storage-Tank Construction: ASME-code, steel vertical arrangement.
  - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing. DN 50 and Smaller: Threaded ends in accordance with ASME B1.20.1. DN 65 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.
  - b. Pressure Rating: 150 psig
  - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed, Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - c. Insulation: Comply with ASHRAE/IES 90.1.
  - d. Jacket: Steel with enameled finish or high-impact composite material.
  - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
  - f. Temperature Control: Adjustable thermostat.
  - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
  - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

### B. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

1. Manufacturers: As indicated on drawings.
2. Standard: UL 174.
  - a. Storage-Tank Construction: ASME-code, steel, vertical arrangement.
  - b. Tappings: ASME B1.20.1 pipe thread.
  - c. Pressure Rating: 150 psig.
  - d. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
3. Factory-Installed, Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
  - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - d. Insulation: Comply with ASHRAE/IES 90.1.
  - e. Jacket: Steel with enameled finish or high-impact composite material.
  - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
  - g. Heating Elements: Electric, screw-in immersion type.
  - h. Temperature Control: Adjustable thermostat.
  - i. Safety Control: High-temperature-limit cutoff device or system.
  - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

## 2.03 DOMESTIC-WATER HEATER ACCESSORIES

### A. Domestic-Water Expansion Tanks:

1. Manufacturers: As indicated on drawings.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than DN 20 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 125-psig-maximum outlet pressure unless otherwise indicated.
- F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

## **2.04 SOURCE QUALITY CONTROL**

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## **PART 3 - EXECUTION**

### **3.01 DOMESTIC-WATER HEATER INSTALLATION**

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on wall-mounted structural shelf.
  1. Maintain manufacturer's recommended clearances.
  2. Arrange units so controls and devices that require servicing are accessible.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.

5. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."
- F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- I. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 22 11 19 "Domestic Water Piping Specialties."
- J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- K. Fill electric, domestic-water heaters with water.
- L. Charge domestic-water expansion tanks with air to required system pressure.
- M. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.
- N. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### **3.02 PIPING CONNECTIONS**

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### **3.03 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

**END OF SECTION**

**SECTION 22 42 13.13  
COMMERCIAL WATER CLOSETS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
1. Floor-mounted, bottom-outlet water closets.
  2. Wall-mounted water closets.
  3. Flushometer valves.
  4. Toilet seats.
  5. Supports.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.03 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data.

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Standards:
1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
  2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
  3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
  4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
  5. Comply with ASME A112.6.1M for water-closet supports.
  6. Comply with ICC A117.1 for ADA-compliant water closets.
  7. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
  8. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

**2.02 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS**

- A. Water Closets - Floor Mounted, Bottom Outlet, Top Spud:
1. Manufacturers: As indicated on drawings.
  2. Bowl:
    - a. Material: Vitreous china.
    - b. Type: Siphon jet.
    - c. Style: Flushometer valve.
    - d. Height: Standard and ADA compliant.
    - e. Rim Contour: Elongated.
    - f. Water Consumption: 1.6 gal. per flush.
    - g. Spud Size and Location: NPS 1-1/2; top.
    - h. Color: White.



## **2.03 WALL-MOUNTED WATER CLOSETS**

### **A. Water Closets - Wall Mounted, Top Spud.**

1. Manufacturers: As indicated on drawings.
2. Bowl:
  - a. Material: Vitreous china.
  - b. Type: Siphon jet.
  - c. Style: Flushometer valve.
  - d. Mounting Height: Standard and ADA compliant.
  - e. Rim Contour: Elongated.
  - f. Water Consumption: 1.6 gal. per flush.
  - g. Spud Size and Location: NPS 1-1/2; top.
  - h. Color: White.

## **2.04 TOILET SEATS**

### **A. Toilet Seats: .**

1. Manufacturers: As indicated on drawings.
2. Material: Plastic.
3. Type: Commercial (Heavy duty).
4. Shape: Elongated rim, open front.
5. Hinge: Check .
6. Hinge Material: Noncorroding metal.
7. Seat Cover: Not required.
8. Color: White.

## **2.05 SUPPORTS**

### **A. Water-Closet Carrier:**

1. Manufacturers: As indicated on drawings.
2. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

#### **A. Water-Closet Installation:**

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

#### **B. Support Installation:**

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

#### **C. Install toilet seats on water closets.**

#### **D. Wall Flange and Escutcheon Installation:**

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- E. Joint Sealing:
  1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  2. Match sealant color to water-closet color.
  3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

### **3.02 CONNECTIONS**

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

### **3.03 ADJUSTING**

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

### **3.04 CLEANING AND PROTECTION**

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

## **SECTION 22 42 13.16 COMMERCIAL URINALS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Urinals.
  - 2. Flushometer valves.

#### **1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### **1.03 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

### **PART 2 - PRODUCTS**

#### **2.01 WALL-HUNG URINALS**

- A. Urinals: Wall hung, back outlet, washout, accessible.
  - 1. Manufacturers: As indicated on drawings.
  - 2. Fixture:
    - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    - b. Material: Vitreous china.
    - c. Type: Washout with extended shields.
    - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
    - e. Water Consumption: Low.
    - f. Spud Size and Location: NPS 3/4, top.
    - g. Outlet Size and Location: NPS 2, back.
    - h. Color: White.
  - 3. Waste Fitting:
    - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
    - b. Size: NPS 2.
  - 4. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights..
  - 5. Urinal Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

#### **2.02 URINAL FLUSHOMETER VALVES**

- A. Lever-Handle, Diaphragm Flushometer Valves:
  - 1. Manufacturers: As indicated on drawings.
  - 2. Standard: ASSE 1037.
  - 3. Minimum Pressure Rating: 125 psig.
  - 4. Features: Include integral check stop and backflow-prevention device.
  - 5. Material: Brass body with corrosion-resistant components.
  - 6. Exposed Flushometer-Valve Finish: Chrome plated.
  - 7. Style: Exposed.
  - 8. Consumption: 0.5 gal. per flush.

9. Minimum Inlet: NPS 3/4.
10. Minimum Outlet: NPS 1-1/4.

## **2.03 SUPPORTS**

- A. Type I Urinal Carrier:
  1. Manufacturers: As indicated on drawings.
  2. Standard: ASME A112.6.1M.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Urinal Installation:
  1. Install urinals level and plumb according to roughing-in drawings.
  2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
  3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
  4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
  5. Install trap-seal liquid in waterless urinals.
- B. Support Installation:
  1. Install supports, affixed to building substrate, for wall-hung urinals.
  2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
  3. Use carriers without waste fitting for urinals with tubular waste piping.
  4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
- C. Flushometer-Valve Installation:
  1. Install flushometer-valve water-supply fitting on each supply to each urinal.
  2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
  3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
  4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- D. Wall Flange and Escutcheon Installation:
  1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
  2. Install deep-pattern escutcheons if required to conceal protruding fittings.
  3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- E. Joint Sealing:
  1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  2. Match sealant color to urinal color.
  3. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

### **3.03 CONNECTIONS**

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

### **3.04 ADJUSTING**

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### **3.05 CLEANING AND PROTECTION**

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

**SECTION 22 42 16.13  
COMMERCIAL LAVATORIES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Lavatories.
  - 2. Faucets.
  - 3. Supports.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

**1.03 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Servicing and adjustments of automatic faucets.

**PART 2 - PRODUCTS**

**2.01 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES**

- A. Lavatory: Vitreous china, wall mounted, with back.
  - 1. Manufacturers: As indicated on drawings.
  - 2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: For wall hanging.
    - c. Nominal Size: Rectangular, 22 by 18 inches.
    - d. Faucet-Hole Punching: Three holes, 4-inch centers.
    - e. Faucet-Hole Location: Top.
    - f. Color: White.
    - g. Mounting Material: Chair carrier.
  - 3. Support: Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.
  - 4. Lavatory Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

**2.02 SOLID-BRASS, MANUALLY OPERATED FAUCETS**

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Manual-type, single-control mixing two-handle mixing, commercial, solid-brass valve.
  - 1. Manufacturers: As indicated on drawings.
  - 2. Standard: ASME A112.18.1/CSA B125.1.
  - 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
  - 4. Body Type: Centerset.
  - 5. Body Material: Commercial, solid brass.

6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 0.5 gpm.
8. Maximum Flow: 0.25 gal. per metering cycle.
9. Mounting Type: Deck, exposed.
10. Valve Handle(s): Single lever.
11. Spout: Rigid type.
12. Spout Outlet: Laminar flow.

### 2.03 SUPPORTS

- A. Type II Lavatory Carrier:
  1. Manufacturers: As indicated on drawings.
  2. Standard: ASME A112.6.1M.

### 2.04 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  1. NPS 3/8.
  2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

### 2.05 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
  1. Size: NPS 1-1/2 by NPS 1-1/4.
  2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
  3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.

- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

### **3.03 CONNECTIONS**

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

### **3.04 ADJUSTING**

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### **3.05 CLEANING AND PROTECTION**

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

**END OF SECTION**



**SECTION 22 42 16.16  
COMMERCIAL SINKS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Service basins.
  - 2. Kitchen/utility sinks.
  - 3. Sink faucets.
  - 4. Supply fittings.
  - 5. Waste fittings.

**1.02 ACTION SUBMITTALS**

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

**1.03 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

**1.04 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**PART 2 - PRODUCTS**

**2.01 SERVICE BASINS**

- A. Service Basins: Plastic, floor mounted.
  - 1. Manufacturers: As indicated on drawings.
  - 2. Fixture:
    - a. Standard: IAPMO/ANSI Z124.6.
    - b. Material: Cast polymer.
    - c. Nominal Size: 24 by 24 by 10 inches.
    - d. Tiling Flange: Not required.
    - e. Rim Guard: On all top surfaces.
    - f. Color: Not applicable.
    - g. Drain: Grid with NPS 3 outlet.
  - 3. Mounting: On floor and flush to wall.

**2.02 KITCHEN/UTILITY SINKS**

- A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted:
  - 1. Fixture:
    - a. Standard: ASME A112.19.3/CSA B45.4.
    - b. Type: Stainless steel, self-rimming, sound-deadened unit
    - c. Material: 18 gauge, Type 304 stainless steel.
  - 2. Supply Fittings:
    - a. Standard: ASME A112.18.1/CSA B125.1.
    - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      - 1) Operation: Wheel handle.

- 2) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
3. Waste Fittings:
  - a. Standard: ASME A112.18.2/CSA B125.2.
  - b. Trap(s):
    - 1) Material:
      - a) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
  - c. Continuous Waste:
    - 1) Material: Chrome-plated, 17-gauge brass tube.
4. Mounting: On counter with sealant.

### 2.03 SINK FAUCETS

- A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, two-lever-handle mixing valve.
  1. Commercial, Solid-Brass Faucets:
    - a. Manufacturers: As indicated on drawings.
  2. Standard: ASME A112.18.1/CSA B125.1.
  3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
  4. Body Type: Centerset.
  5. Body Material: Commercial, solid brass.
  6. Finish: Chrome plated.
  7. Maximum Flow Rate: 2.2 gpm.
  8. Handle(s): Wrist blade, 4 inches.
  9. Mounting Type: Deck, exposed.
  10. Spout Type: Rigid, solid brass Rigid, solid brass with wall brace Swing, round tubular Rigid gooseneck Swivel gooseneck.
  11. Vacuum Breaker: Required for hose outlet.
  12. Spout Outlet: Laminar flow Hose thread according to ASME B1.20.7 Spray.

### 2.04 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  1. NPS 3/8.
  2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

### 2.05 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall p-trap and chrome-plated brass or steel wall flange.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
  1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.14 "Check Valves for Plumbing Piping."
  2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

### **3.03 CONNECTIONS**

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

### **3.04 ADJUSTING**

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

### **3.05 CLEANING AND PROTECTION**

- A. After completing installation of sinks, inspect and repair damaged finishes.

- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

**END OF SECTION**

**SECTION 23 05 17**  
**SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.
  - 6. Silicone sealants.
- B. Related Requirements:
  - 1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

**1.03 ACTION SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.01 SLEEVES**

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
- E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

**2.02 STACK-SLEEVE FITTINGS**

- A. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

**2.03 SLEEVE-SEAL SYSTEMS**

- A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20-psig minimum.
3. Sealing Elements: EPDM-rubber, High-temperature-silicone or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Carbon steel, Composite plastic or Stainless steel, Type 316.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 or Stainless steel of length required to secure pressure plates to sealing elements.

## **2.04 SLEEVE-SEAL FITTINGS**

- A. Description:
  1. Manufactured plastic, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
  2. Plastic or rubber waterstop collar with center opening to match piping OD.

## **2.05 GROUT**

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## **2.06 SILICONE SEALANTS**

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

# **PART 3 - EXECUTION**

## **3.01 SLEEVE INSTALLATION**

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 25-mm annular clear space between piping and concrete slabs and walls.
  1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

### **3.02 STACK-SLEEVE-FITTING INSTALLATION**

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
  3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
  4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  5. Using waterproof silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated, Horizontal Assembly, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

### **3.03 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### **3.04 SLEEVE-SEAL-FITTING INSTALLATION**

- A. Install sleeve-seal fittings as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeve-seal fittings.

### **3.05 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

### **3.06 SLEEVE AND SLEEVE-SEAL SCHEDULE**

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls Above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron sleeves, Galvanized-steel pipe sleeves or Sleeve-seal fittings.
    - b. Piping NPS 6 and Larger: Cast-iron wall sleeves or Galvanized-steel pipe sleeves.
  2. Exterior Concrete Walls Below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system, Galvanized-steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system, Galvanized-steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system. Galvanized-steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  4. Concrete Slabs Above Grade:
    - a. Piping Smaller Than NPS 6: Galvanized-steel pipe sleeves, Sleeve-seal fittings or Molded-PE or -PP sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel pipe sleeves.
  5. Interior Partitions:
    - a. Piping Smaller Than NPS 6: Galvanized-steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

**END OF SECTION**



**SECTION 23 05 29**  
**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Fastener systems.
  - 2. Equipment supports.
- B. Related Requirements:
  - 1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Section 23 31 13 "Metal Ducts" for duct hangers and supports.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.
  - 4. Pipe stands.
  - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Include design calculations for designing trapeze hangers.

**1.04 QUALITY ASSURANCE**

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

## **2.02 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## **2.03 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## **2.04 MATERIALS**

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 28-day compressive strength.

# **PART 3 - EXECUTION**

## **3.01 APPLICATION**

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus.

## **3.02 HANGER AND SUPPORT INSTALLATION**

- A. Fastener System Installation:
  1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- C. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- D. 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.
- E. Install lateral bracing with pipe hangers and supports to prevent swaying.
- F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

### **3.03 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.04 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### **3.05 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.06 PAINTING**

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### **3.07 HANGER AND SUPPORT SCHEDULE**

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- E. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  - 6. C-Clamps (MSS Type 23): For structural shapes.
  - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  - 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  - 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  - 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- F. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- G. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- H. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION**

**SECTION 23 05 53**  
**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Duct labels.
  - 4. Stencils.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

**PART 2 - PRODUCTS**

**2.01 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, stainless steel, or anodized aluminum, minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: White or Yellow
  - 3. Background Color: Black.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on A4 bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## **2.02 WARNING SIGNS AND LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White or Yellow
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

## **2.03 DUCT LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White or Yellow
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

## **2.04 STENCILS**

- A. Stencils for Ducts:
  1. Lettering Size: Minimum letter height of 1-1/2 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
  2. Stencil Material: Fiberboard or metal.
  3. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
  4. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.
- B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
  1. Lettering Size: Minimum letter height of 1-1/2 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
  2. Stencil Material: Fiberboard or metal.
  3. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
  4. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.02 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### **3.03 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.04 DUCT LABEL INSTALLATION**

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  1. Blue: For cold-air supply ducts.
  2. Yellow For hot-air supply ducts.
  3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.



- C. Locate labels near points where ducts enter or exit concealed spaces at maximum intervals of 25 ft in each space where ducts are exposed or concealed by removable ceiling system.

**END OF SECTION**

**SECTION 23 05 93**  
**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Testing, Adjusting, and Balancing of Air Systems:
    - a. Constant-volume air systems.

**1.03 DEFINITIONS.**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Within 45 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Certified TAB reports.
- D. Sample report forms.
- E. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

**1.05 QUALITY ASSURANCE**

- A. TAB Specialists Qualifications, Certified by AABC or NEBB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

## **1.06 FIELD CONDITIONS**

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## **PART 2 - EXECUTION**

### **2.01 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## **2.02 PREPARATION**

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.

## **2.03 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
  - 3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
  - 4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 "HVAC Insulation".
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

## **2.04 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT**

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Motors.
  - 2. Pumps.
  - 3. Fans and ventilators.
  - 4. Terminal units.
  - 5. Furnaces.
  - 6. Radiant heaters.

7. Unit heaters.
8. Condensing units.
9. Air-handling units.
10. Heating and ventilating units.
11. Split-system air conditioners.
12. Heat pumps.
13. Coils.
14. Fan coil units.
15. Unit ventilators.

## **2.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

## **2.06 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  4. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
  1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
  1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  2. Re-measure and confirm that total airflow is within design.
  3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
  4. Mark all final settings.
  5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  6. Measure and record all operating data.
  7. Record final fan-performance data.

## **2.07 PROCEDURES FOR AIR-COOLED CONDENSING UNITS**

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

## **2.08 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Measure, adjust, and record the following data for each electric heating coil:
  1. Nameplate data.
  2. Airflow.
  3. Entering- and leaving-air temperature at full load.
  4. Air pressure drop.
  5. Voltage and amperage input of each phase at full load.
  6. Calculated kilowatt at full load.
  7. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
  1. Dry-bulb temperature of entering and leaving air.
  2. Wet-bulb temperature of entering and leaving air.
  3. Airflow.
  4. Air pressure drop.
  5. Entering and leaving refrigerant pressure and temperatures.

## **2.09 DUCT LEAKAGE TESTS**

- A. Witness the duct leakage testing performed by Installer.

- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

## **2.10 HVAC CONTROLS VERIFICATION.**

- A. In conjunction with system balancing, perform the following:
  - 1. Verify HVAC control system is operating within the design limitations.
  - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
  - 3. Verify that controllers are calibrated and function as intended.
  - 4. Verify that controller set points are as indicated.
  - 5. Verify the operation of lockout or interlock systems.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

## **2.11 TOLERANCES**

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent
  - 2. Air Outlets and Inlets: Plus or minus 10 percent
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

## **2.12 PROGRESS REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

## **2.13 FINAL REPORT**

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Fan curves.
  - 2. Manufacturers' test data.
  - 3. Field test reports prepared by system and equipment installers.
  - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.

4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report.  
Number each page in the report.
11. Summary of contents, including the following:
  - a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Heating coil, dry-bulb conditions.
  - e. Face and bypass damper settings at coils.
  - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
  - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
  1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Duct, outlet, and inlet sizes.
  3. Terminal units.
  4. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units, include the following:
  1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, frame type, and size.
    - b. Horsepower and speed.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan speed.



- d. Inlet and discharge static pressure in inches wg.
  - e. For each filter bank, filter static-pressure differential in inches wg.
  - f. Preheat-coil static-pressure differential in inches wg.
  - g. Cooling-coil static-pressure differential in inches wg.
  - h. Heating-coil static-pressure differential in inches wg.
  - i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
  - j. Outdoor airflow in cfm.
  - k. Return airflow in cfm.
  - l. Outdoor-air damper position.
  - m. Return-air damper position.
- F. Apparatus-Coil Test Reports:
- 1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in o.c.
    - f. Make and model number.
    - g. Face area in sq. ft.
    - h. Tube size in NPS.
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Average face velocity in fpm.
    - c. Air pressure drop in inches wg.
    - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    - e. Return-air, wet- and dry-bulb temperatures in deg F.
    - f. Entering-air, wet- and dry-bulb temperatures in deg F.
    - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    - h. Refrigerant expansion valve and refrigerant types.
    - i. Refrigerant suction pressure in psig.
    - j. Refrigerant suction temperature in deg F.
- G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Fuel type in input data.
    - g. Output capacity in Btu/h.
    - h. Ignition type.
    - i. Burner-control types.
    - j. Motor horsepower and speed.
    - k. Motor volts, phase, and hertz.
    - l. Motor full-load amperage and service factor.
    - m. Sheave make, size in inches, and bore.
    - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - 2. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Entering-air temperature in deg F.

- c. Leaving-air temperature in deg F.
  - d. Air temperature differential in deg F.
  - e. Entering-air static pressure in inches wg.
  - f. Leaving-air static pressure in inches wg.
  - g. Air static-pressure differential in inches wg.
  - h. Low-fire fuel input in Btu/h.
  - i. High-fire fuel input in Btu/h.
  - j. Manifold pressure in inches wg.
  - k. High-temperature-limit setting in deg F.
  - l. Operating set point in Btu/h.
  - m. Motor voltage at each connection.
  - n. Motor amperage for each phase.
  - o. Heating value of fuel in Btu/h.
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btu/h.
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Airflow rate in cfm.
    - i. Face area in sq. ft.
    - j. Minimum face velocity in fpm.
  - 2. Test Data (Indicated and Actual Values):
    - a. Heat output in Btu/h.
    - b. Airflow rate in cfm.
    - c. Air velocity in fpm.
    - d. Entering-air temperature in deg F.
    - e. Leaving-air temperature in deg F.
    - f. Voltage at each connection.
    - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches, and bore.
    - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - 2. Motor Data:
    - a. Motor make, frame type, and size.
    - b. Horsepower and speed.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - g. Number, make, and size of belts.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.

- b. Total system static pressure in inches wg.
  - c. Fan speed.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  - 1. Report Data:
    - a. System fan and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq inches.
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- K. Air-Terminal-Device Reports:
  - 1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- L. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

## 2.14 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 25 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
  - 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

## **2.15 ADDITIONAL TESTS**

- A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION**

## **SECTION 23 07 13 DUCT INSULATION**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

#### **1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## **1.06 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## **1.07 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### **2.01 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type II for sheet materials.
  - 1. Areoflex USA
  - 2. Armacell LLC
  - 3. K-Flex USA.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. CertainTeed Corp.
  - 2. Johns Manville
  - 3. Knauf Insulation

### **2.02 FIRE-RATED INSULATION SYSTEMS**

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 1 or 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. Johns Manville

- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1 or 2 hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  - 1. 3m
  - 2. Thermal Ceramics
  - 3. Unifrax Corporation

## **2.03 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aeroseal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## **2.04 MASTICS AND COATINGS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
    - b. Eagle Bridges - Marathon Industries; 501.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
    - d. Mon-Eco Industries, Inc.; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F.
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F.
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

## 2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.



- c. Vimasco Corporation; 713 and 714.
- 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
- 4. Service Temperature Range: 0 to plus 180 deg F.
- 5. Color: White.

## 2.06 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. Mon-Eco Industries, Inc.; 44-05.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: Aluminum.
  - 6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: White.
  - 6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.07 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
  - 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
  - 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

## **2.09 FIELD-APPLIED CLOTHS**

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

## **2.10 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  - 2. Adhesive: As recommended by jacket material manufacturer.
  - 3. Color: White.
- D. Metal Jacket:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  - 2. Aluminum Jacket: Comply with ASTM B 209M, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Finish and thickness are indicated in field-applied jacket schedules.
    - b. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    - c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper of 2.5-mil-thick polysurlyn.
- E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Polyguard Products, Inc.; Alumaguard 60.

## **2.11 TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.

- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
  - c. Compac Corporation; 104 and 105.
  - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
- 2. Width: 3 inches.
- 3. Thickness: 11.5 mils.
- 4. Adhesion: 90 ounces force/inch in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch in width.
- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 6.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  - 2. Width: 2 inches.
  - 3. Thickness: 6 mils.
  - 4. Adhesion: 64 ounces force/inch in width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.
  - 2. Width: 2 inches.
  - 3. Thickness: 3.7 mils.
  - 4. Adhesion: 100 ounces force/inch in width.
  - 5. Elongation: 5 percent.
  - 6. Tensile Strength: 34 lbf/inch in width.

## 2.12 SECUREMENTS

- A. Bands:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ITW Insulation Systems; Gerrard Strapping and Seals.
    - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
  - 2. Aluminum: ASTM B 209M, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
  1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; CD.
      - 3) Midwest Fasteners, Inc.; CD.
      - 4) Nelson Stud Welding; TPA, TPC, and TPS.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; CHP-1.
      - 2) GEMCO; Cupped Head Weld Pin.
      - 3) Midwest Fasteners, Inc.; Cupped Head.
      - 4) Nelson Stud Welding; CHP.
  3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      - 2) GEMCO; Perforated Base.
      - 3) Midwest Fasteners, Inc.; Spindle.
    - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, galvanized steel.
  1. Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. C & F Wire.

## 2.13 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### **3.03 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### **3.04 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Seal penetrations through fire-rated assemblies.

### **3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.06 INSTALLATION OF MINERAL-FIBER INSULATION**

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### **3.07 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### **3.08 FIRE-RATED INSULATION SYSTEM INSTALLATION**

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies.



### **3.09 FINISHES**

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### **3.10 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.11 DUCT INSULATION SCHEDULE, GENERAL**

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- B. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums and casings.
  - 5. Flexible connectors.
  - 6. Vibration-control devices.
  - 7. Factory-insulated access panels and doors.

### **3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. Concealed, round, supply-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  - 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- B. Concealed, round, exhaust-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  - 2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- C. Concealed, rectangular, supply-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.

2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- D. Concealed, rectangular, return-air duct insulation shall be one of the following:
  1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
- E. Exposed, rectangular, supply-air duct insulation shall be one of the following:
  1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  3. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  4. Polyolefin: 1 inch thick.
- F. Exposed, rectangular, return-air and outdoor-air duct insulation shall be one of the following:
  1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  3. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-6 or better.
  4. Polyolefin: 1 inch thick.

### **3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  1. None.
- D. Ducts and Plenums, Exposed, ABOVE 5':
  1. PVC: 20 mils thick.
  2. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.020 inch thick.
  3. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.020 inch thick.
- E. Ducts and Plenums, Exposed, BELOW 5':
  1. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch thick.
  2. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch thick.

**END OF SECTION**

## **SECTION 23 09 23.12 CONTROL DAMPERS**

### **1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes the following types of control dampers and actuators for DDC systems:
  - 1. Rectangular control dampers.
  - 2. Round control dampers.
  - 3. General control-damper actuator requirements.
  - 4. Electric and electronic actuators.

#### **1.3 DEFINITIONS**

- A. DDC: Direct-digital control.
- B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including the following:
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  - 3. Product description with complete technical data, performance curves, and product specification sheets.
  - 4. Installation instructions, including factors affecting performance.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

### **2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

- C. Delegated Design: Engage a qualified professional, as defined in Section 01 40 00 "Quality Requirements," to size products where indicated as delegated design.
- D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.
- F. Environmental Conditions:
  - 1. Provide electric control-damper actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control-damper actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.
    - a. Hazardous Locations: Explosion-proof rating for condition.
- G. Selection Criteria:
  - 1. Control dampers shall be suitable for operation at following conditions:
    - a. Supply Air
    - b. Return Air
    - c. Outdoor Air
    - d. Mixed Air
    - e. Exhaust Air
  - 2. Fail positions unless otherwise indicated:
    - a. Supply Air: Open.
    - b. Return Air: Open.
    - c. Outdoor Air: Open.
    - d. Mixed Air: Open.
    - e. Exhaust Air: Open.
  - 3. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
  - 4. Select modulating dampers for a pressure drop of 2 percent of fan total static pressure unless otherwise indicated.
  - 5. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.
  - 6. Pneumatic, two-position control dampers shall provide a smooth opening and closing characteristic slow enough to avoid excessive pressure. Dampers with pneumatic actuators shall have an adjustable opening time (valve full closed to full open) and an adjustable closing time (valve full open to full closed) ranging from zero to 10 seconds. Opening and closing times shall be independently adjustable.
  - 7. Control-damper, pneumatic-control signal shall not exceed 200 feet. For longer distances, provide an electric/electronic control signal to the damper and an electric solenoid valve or electro-pneumatic transducer at the damper to convert the control signal to pneumatic.

## 2.2 RECTANGULAR CONTROL DAMPERS

- A. General Requirements:
  - 1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
  - 2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
  - 3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.
- B. Rectangular Dampers with Aluminum Airfoil Blades:
  - 1. Performance:

- a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
  - b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 6000 fpm.
  - d. Temperature: Minus 40 to plus 185 deg F
  - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
  - f. Damper shall have AMCA seal for both air leakage and air performance.
2. Construction:
- a. Frame:
    - 1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.
    - 2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch
    - 3) Width not less than 5 inches
  - b. Blades:
    - 1) Hollow, airfoil, extruded aluminum.
    - 2) Parallel or opposed blade configuration as required by application.
    - 3) Material: ASTM B211, Alloy 6063 T5 aluminum, 0.07 inch thick.
    - 4) Width not to exceed 6 inches
    - 5) Length as required by close-off pressure, not to exceed 48 inches
  - c. Seals:
    - 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
    - 2) Jambs: Stainless steel, compression type.
  - d. Axles: 0.5-inch-diameter plated steel, mechanically attached to blades.
  - e. Bearings:
    - 1) Molded synthetic or stainless-steel sleeve mounted in frame.
    - 2) Where blade axles are installed in vertical position, provide thrust bearings.
  - f. Linkage:
    - 1) Concealed in frame.
    - 2) Constructed of aluminum and plated steel.
    - 3) Hardware: Stainless steel.
  - g. Transition:
    - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
    - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
    - 3) Damper size and sleeve shall be connection size plus 2 inches
    - 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
    - 5) Sleeve material shall match adjacent duct.
  - h. Additional Corrosion Protection for Corrosive Environments:
    - 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
    - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.
3. Airflow Measurement:
- a. Where indicated, provide damper assembly with integral airflow monitoring.
  - b. Zero- to 10-V dc or 4- to 20-mA scaled output signal for remote monitoring of actual airflow.
  - c. Accuracy shall be within 5 percent of the actual flow rate between the range of minimum and design airflow. For applications with a large variation in range between the minimum and design airflow, configure the damper sections and flow

- measurement assembly as required to comply with the stated accuracy over the entire modulating range.
  - d. Provide a straightening device as part of the flow measurement assembly to achieve the specified accuracy with configuration indicated.
  - e. Suitable for operation in untreated and unfiltered air.
  - f. Provide temperature and altitude compensation and correction to maintain accuracy over temperature range encountered at site altitude.
  - g. Provide automatic zeroing feature.
- 4. Airflow Control:
  - a. Where indicated, provide damper assembly with integral airflow measurement and control.
  - b. A factory-furnished and -calibrated controller shall be programmed, in nonvolatile EPROM, with application-specific airflow set point and range.
  - c. The controller and actuator shall communicate to control the desired airflow.
  - d. The controller shall receive a zero- to 10-V dc input signal and report a zero- to 20-mA output signal that is proportional to the airflow.
  - e. Airflow measurement and control range shall be suitable for operation between 150 to 2000 fpm
  - f. Ambient Operating Temperature Range: Minus 40 to plus 140 deg F
  - g. Ambient Operating Humidity Range: 5 to 95 percent relative humidity, non-condensing.
  - h. Provide unit with control transformer rated for not less than 85 VA. Provide transformer with primary and secondary protection and primary disconnecting means. Coordinate requirements with field power connection.
  - i. Provide screw terminals for interface to field wiring.
  - j. Factory mount electronics within a NEMA 250, Type 1 painted steel enclosure.
- C. Rectangular Dampers with Steel Airfoil Blades:
  - 1. Performance:
    - a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
    - b. Pressure Drop: 0.06-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
    - c. Velocity: Up to 6000 fpm
    - d. Temperature: Minus 40 to plus 185 deg F
    - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
    - f. Damper shall have AMCA seal for both air leakage and air performance.
  - 2. Construction:
    - a. Frame:
      - 1) Material: ASTM A653/A653M galvanized-steel profiles, 0.06 inch thick.
      - 2) Hat-shaped channel with integral flanges. Mating face shall be a minimum of 1 inch.
      - 3) Width not less than 5 inches.
    - b. Blades:
      - 1) Hollow, airfoil, galvanized steel.
      - 2) Parallel or opposed blade configuration as required by application.
      - 3) Material: ASTM A653/A653M galvanized steel, 0.05 inch thick.
      - 4) Width not to exceed 6 inches
      - 5) Length as required by close-off pressure, not to exceed 48 inches
    - c. Seals:
      - 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
      - 2) Jambs: Stainless steel, compression type.
    - d. Axles: 0.5-inch-diameter plated steel, mechanically attached to blades.
    - e. Bearings:

- 1) Stainless steel mounted in frame.
    - 2) Where blade axles are installed in vertical position, provide thrust bearings.
  - f. Linkage:
    - 1) Concealed in frame.
    - 2) Constructed of aluminum and plated steel.
    - 3) Hardware: Stainless steel.
  - g. Transition:
    - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
    - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
    - 3) Damper size and sleeve shall be connection size plus 2 inches.
    - 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
    - 5) Sleeve material shall match adjacent duct.
  - h. Additional Corrosion Protection for Corrosive Environments:
    - 1) Provide epoxy finish for surfaces in contact with airstream.
    - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.
- D. Industrial-Duty Rectangular Dampers with Steel Airfoil Blades:
  - 1. Performance:
    - a. Leakage: Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
    - b. Pressure Drop: 0.06-in. wg at 2000 fpm across a 48-by-48-inch damper when tested according to AMCA 500-D, figure 5.3.
    - c. Velocity: Up to 4000 fpm.
    - d. Temperature: Minus 40 to plus 250 deg F.
    - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length, minimum 10-in. wg.
  - 2. Construction:
    - a. Frame:
      - 1) Material: Galvanized steel, 0.11 inch thick.
      - 2) C-shaped channel. Mating face shall be a minimum of 1 inch.
      - 3) Width not less than 3 inches
    - b. Blades:
      - 1) Hollow, airfoil, galvanized steel.
      - 2) Parallel or opposed blade configuration as required by application.
      - 3) Material: Galvanized steel, 0.06 inch thick.
      - 4) Width not to exceed 6 inches
      - 5) Length not to exceed 48 inches.
    - c. Seals:
      - 1) Blades: Replaceable, mechanically attached EPDM or extruded silicone.
      - 2) Jambs: Stainless steel, double compression type.
    - d. Axles: 0.5- or 0.75-inch-diameter plated steel, mechanically attached to blades and continuous from end to end.
    - e. Bearings:
      - 1) Stainless-steel sleeve type mounted in frame.
      - 2) Where blade axles are installed in vertical position, provide thrust bearings.
    - f. Linkage:
      - 1) Face linkage exposed to airstream.
      - 2) Constructed of plated steel.
      - 3) Hardware: Stainless steel.
- E. Rectangular Dampers with Aluminum Flat Blades:
  - 1. Performance:

- a. Leakage: Leakage shall not exceed 3.2 cfm/sq. ft. against 1-in. wg differential static pressure.
  - b. Pressure Drop: 0.07-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 2000 fpm.
  - d. Temperature: Minus 50 to plus 250 deg F.
  - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length, not to exceed 3-in. wg.
  - f. Damper shall have AMCA seal for both air leakage and air performance.
2. Construction:
- a. Frame:
    - 1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.12 inch thick.
    - 2) Hat-shaped channel.
    - 3) Width not less than 5 inches.
  - b. Blades:
    - 1) Flat blades of extruded aluminum.
    - 2) Parallel or opposed blade configuration as required by application.
    - 3) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.12 inch thick.
    - 4) Width not to exceed 6 inches.
    - 5) Length as required by close-off pressure, not to exceed 48 inches.
  - c. Seals:
    - 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl or plastic composite.
    - 2) Jambs: Stainless steel, compression type.
  - d. Axles: 0.5-inch-diameter plated steel, mechanically attached to blades.
  - e. Bearings:
    - 1) Molded-synthetic sleeve, mounted in frame.
    - 2) Where blade axles are installed in vertical position, provide thrust bearings.
  - f. Linkage:
    - 1) Concealed in frame.
    - 2) Constructed of plated steel.
    - 3) Hardware: Stainless steel.
  - g. Transition:
    - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
    - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
    - 3) Damper size and sleeve shall be connection size plus 2 inches.
    - 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
    - 5) Sleeve material shall match adjacent duct.
  - h. Additional Corrosion Protection for Corrosive Environments:
    - 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
    - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

F. Rectangular Dampers with Steel Flat Blades:

- 1. Performance:
  - a. Leakage: Leakage shall not exceed 4.8 cfm/sq. ft. against 1-in. wg differential static pressure.
  - b. Pressure Drop: 0.1-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 1500 fpm.



- d. Temperature: Minus 25 to plus 180 deg F.
  - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length, not to exceed 4-in. wg.
  - f. Damper shall have AMCA seal for both air leakage and air performance.
2. Construction:
- a. Frame:
    - 1) Material: Galvanized steel, 0.06 inch thick.
    - 2) Hat-shaped channel with integral flanges.
    - 3) Width not less than 5 inches.
  - b. Blades:
    - 1) Flat blades with multiple grooves positioned axially for reinforcement.
    - 2) Parallel or opposed blade configuration as required by application.
    - 3) Material: Galvanized steel, 0.06 inch thick.
    - 4) Width not to exceed 6 inches.
    - 5) Length as required by close-off pressure, not to exceed 48 inches.
  - c. Seals:
    - 1) Blades: Replaceable, mechanically attached, PVC-coated polyester.
    - 2) Jambs: Stainless steel, compression type.
  - d. Axles: 0.5-inch-diameter plated steel, mechanically attached to blades.
  - e. Bearings:
    - 1) Molded-synthetic sleeve, mounted in frame.
    - 2) Where blade axles are installed in vertical position, provide thrust bearings.
  - f. Linkage:
    - 1) Concealed in frame.
    - 2) Constructed of plated steel.
    - 3) Hardware: Stainless steel.
- G. Insulated Rectangular Dampers:
1. Performance:
- a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure and shall not exceed 4.9 cfm/sq. ft. against 4-in. wg differential static pressure at minus 40 deg F.
  - b. Pressure Drop: 0.1-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 4000 fpm.
  - d. Temperature: Minus 100 to plus 185 deg F.
  - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
  - f. Damper shall have AMCA seal for both air leakage and air performance.
2. Construction:
- a. Frame:
    - 1) Material: ASTM B211, Alloy 6063 T5 extruded-aluminum profiles, 0.08 inch thick.
    - 2) C-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
    - 3) Width not less than 4 inches.
    - 4) Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.
    - 5) Damper frame shall be insulated with polystyrafoam on four sides.
  - b. Blades:
    - 1) Hollow shaped, extruded aluminum.
    - 2) Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
    - 3) Parallel or opposed blade configuration as required by application.
    - 4) Material: ASTM B211, Alloy 6063 T5 aluminum, 0.08 inch thick.

- 5) Width not to exceed 6 inches.
- 6) Length as required by close-off pressure, not to exceed 48 inches.
- c. Seals: Blade and frame seals shall be of flexible silicone and secured in an integral slot within the aluminum extrusions.
- d. Axles: 0.44-inch-diameter plated steel, mechanically attached to blades.
- e. Bearings:
  - 1) Bearings shall be composed of a Celcon inner bearing fixed to axle, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
  - 2) Where blade axles are installed in vertical position, provide thrust bearings.
- f. Linkage:
  - 1) Concealed in frame.
  - 2) Constructed of aluminum and plated steel.
  - 3) Hardware: Stainless steel.
- g. Transition:
  - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
  - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
  - 3) Damper size and sleeve shall be connection size plus 2 inches.
  - 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
  - 5) Sleeve material shall match adjacent duct.
- h. Additional Corrosion Protection for Corrosive Environments:
  - 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
  - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

## 2.3 ROUND CONTROL DAMPERS

### A. Round Dampers, Sleeve Type:

- 1. Performance:
  - a. Leakage: Leakage shall not exceed 0.15 cfm/in. of perimeter blade at 4-in. wg differential static pressure.
  - b. Pressure Drop: 0.02-in. wg at 1500 fpm across a 12-inch damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 4000 fpm.
  - d. Temperature: Minus 25 to plus 200 deg F.
  - e. Pressure Rating: 8-in. wg for sizes through 12 inches, 6-in. wg for larger sizes.
- 2. Construction:
  - a. Frame:
    - 1) Material: Galvanized steel, 0.04 in thick.
    - 2) Outward rolled stiffener beads positioned approximately 1 inch inboard of each end.
    - 3) Sleeve-type connection for mating to adjacent ductwork.
    - 4) Size Range: 4 to 24 inches.
    - 5) Length not less than 7 inches.
    - 6) Provide 2-inch sheet metal stand-off for mounting actuator.
  - b. Blade: Double-thickness circular flat blades sandwiched together and constructed of galvanized steel.
  - c. Blade Seal: Polyethylene foam seal sandwiched between two sides of blades and fully encompassing blade edge.
  - d. Axle: 0.5-inch-diameter stainless steel, mechanically attached to blade.
  - e. Bearings: Stainless-steel sleeve pressed into frame.

B. Round Dampers, Flanged Type:

1. Performance:
  - a. Leakage: Leakage shall not exceed 0.15 cfm/in. of perimeter blade at 4-in. wg differential static pressure.
  - b. Pressure Drop: 0.03-in. wg at 1500 fpm across a 12-inch damper when tested according to AMCA 500-D, figure 5.3.
  - c. Velocity: Up to 4000 fpm.
  - d. Temperature: Minus 25 to plus 250 deg F.
  - e. Pressure Rating: 8-in. wg for sizes through 36 inches in diameter, 6-in. wg for larger sizes.
2. Construction:
  - a. Frame:
    - 1) Size Range: 4 to 60 inches.
    - 2) Material: Galvanized steel.
      - a) Sizes through 24 Inches in Diameter: 0.15 inch thick.
      - b) Sizes 26 through 48 Inches in Diameter: 0.25 inch thick.
      - c) Larger Sizes: 0.31 inch thick.
    - 3) Flanges:
      - a) Outward rolled with bolt holes on each end of frame for mating to adjacent ductwork.
      - b) Face: Not less than 1.25 inch for damper sizes through 12 inches in diameter, 1.5 inch for damper sizes 14 through 24 inches in diameter, and 2 inches for larger sizes.
    - 4) Length (Flange Face to Face): Not less than 8 inches.
    - 5) Provide 3-inch sheet metal stand-off for mounting actuator.
  - b. Blade: Reinforced circular flat blade constructed of galvanized steel.
    - 1) Sizes through 24 Inches: 0.15 inch thick.
    - 2) Sizes 26 through 48 Inches: 0.19 inch thick.
    - 3) Larger Sizes: 0.25 inch thick.
  - c. Blade Stop: Full circumference, located in airstream, minimum 0.5 by 0.25 inch galvanized-steel bar.
  - d. Blade Seal: Neoprene, mechanically attached to blade and fully encompassing blade edge.
  - e. Axle: Plated steel, mechanically attached to blade.
    - 1) Sizes through 14 Inches: 0.5 inch in diameter.
    - 2) Sizes 16 through 42 Inches: 0.75 inch in diameter.
    - 3) Larger Sizes: 1 inch in diameter.
  - f. Bearings: Stainless-steel sleeve pressed into frame.

## 2.4 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

- A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.
- B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
- C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
- D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
- E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

- F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
- G. Provide mounting hardware and linkages for connecting actuator to damper.
- H. Select actuators to fail in desired position in the event of a power failure.

## 2.5 ELECTRIC AND ELECTRONIC ACTUATORS

- A. Type: Motor operated, with or without gears, electric and electronic.
- B. Voltage:
  - 1. See Drawings.
  - 2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
  - 3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.
- C. Construction:
  - 1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
  - 2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
  - 3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- D. Field Adjustment:
  - 1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
  - 2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.
- E. Two-Position Actuators: Single direction, spring return or reversing type.
- F. Modulating Actuators:
  - 1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
  - 2. Control Input Signal:
    - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
    - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero-to 10 or 2-to 10-V dc and 4- to 20-mA signals.
    - c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to a pulse duration (length) of signal from a dry-contact closure, triac sink or source controller.
    - d. Programmable Multi-Function:
      - 1) Control input, position feedback, and running time shall be factory or field programmable.
      - 2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
      - 3) Service data, including at a minimum, number of hours powered and number of hours in motion.
- G. Position Feedback:
  - 1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of position.
  - 2. Equip modulating actuators with a position feedback through current signal for remote monitoring.

3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.
- H. Fail-Safe:
1. Where indicated, provide actuator to fail to an end position.
  2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
  3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.
- I. Integral Overload Protection:
1. Provide against overload throughout the entire operating range in both directions.
  2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
- J. Damper Attachment:
1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
  2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
  3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
- K. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F
  2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.
- L. Enclosure:
1. Suitable for ambient conditions encountered by application.
  2. NEMA 250, Type 2 for indoor and protected applications.
  3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
  4. Provide actuator enclosure with a heater and controller where required by application.
- M. Stroke Time:
1. Operate damper from fully closed to fully open within 60 seconds.
  2. Operate damper from fully open to fully closed within 60 seconds.
  3. Move damper to failed position within 15 seconds.
  4. Select operating speed to be compatible with equipment and system operation.
  5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.
- N. Sound:
1. Spring Return: 62 dBA.
  2. Non-Spring Return: 45 dBA.

### **3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment.
- C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Seal penetrations made in fire-rated and acoustically rated assemblies.
- E. Fastening Hardware:
  - 1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- G. Corrosive Environments:
  - 1. Use products that are suitable for environment to which they will be subjected.
  - 2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:
    - a. Laboratory exhaust airstreams.
    - b. Process exhaust airstreams.
  - 3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
  - 4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
  - 5. Where actuators are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### **3.3 ELECTRIC POWER**

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

### **3.4 CONTROL DAMPERS**

- A. Install smooth transitions, not exceeding 15 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
- B. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
  2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
- C. Service Access:
1. Dampers and actuators shall be accessible for visual inspection and service.
  2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 23 33 00 "Air Duct Accessories."
- D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
- E. Attach actuator(s) to damper drive shaft.
- F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

### **3.5 CONNECTIONS**

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

### **3.6 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with damper identification on damper.

### **3.7 CHECKOUT PROCEDURES**

- A. Control-Damper Checkout:
1. Check installed products before continuity tests, leak tests, and calibration.
  2. Check dampers for proper location and accessibility.
  3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
  4. For pneumatic products, verify air supply for each product is properly installed.
  5. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
  6. Verify that control dampers are installed correctly for flow direction.
  7. Verify that proper blade alignment, either parallel or opposed, has been provided.
  8. Verify that damper frame attachment is properly secured and sealed.
  9. Verify that damper actuator and linkage attachment are secure.
  10. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
  11. Verify that damper blade travel is unobstructed.

### **3.8 ADJUSTMENT, CALIBRATION, AND TESTING:**

- A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.

- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

**END OF SECTION**



## **SECTION 23 31 13 METAL DUCTS**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Duct liner.
  - 5. Sealants and gaskets.
  - 6. Hangers and supports.
- B. Related Sections:
  - 1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### **1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
- B. Delegated-Design Submittal:
  - 1. Sheet metal thicknesses.
  - 2. Joint and seam construction and sealing.
  - 3. Reinforcement details and spacing.
  - 4. Materials, fabrication, assembly, and spacing of hangers and supports.

### **PART 2 - PRODUCTS**

#### **2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

## **2.02 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## **2.03 SINGLE-WALL ROUND AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## **2.04 SHEET METAL MATERIALS**

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  - 1. Galvanized Coating Designation: Z180.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Aluminum Sheets: Comply with ASTM B209M Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Factory- or Shop-Applied Antimicrobial Coating:
  - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
  - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
  - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  - 5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- E. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

## 2.05 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
  - 2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA Inc.
    - b. Armacell LLC.
    - c. Rubatex International, LLC
  - 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  - 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

- a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Insulation Pins and Washers:
  1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
  1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
  7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
  9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
  10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.06 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 4 inches
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
  2. Base: Synthetic rubber resin.
  3. Solvent: Toluene and heptane.
  4. Solids Content: Minimum 60 percent.
  5. Shore A Hardness: Minimum 60.
  6. Water resistant.
  7. Mold and mildew resistant.
  8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  9. VOC: Maximum 395 g/L.
  10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  11. Service: Indoor or outdoor.
  12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
  6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## **2.07 HANGERS AND SUPPORTS**

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1M, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## **PART 3 - EXECUTION**

### **3.01 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- L. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include single thickness turning vanes.
  2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- M. Branch Connections: Use lateral or conical branch connections.

### **3.02 INSTALLATION OF EXPOSED DUCTWORK**

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.03 DUCT SEALING**

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-inch wg and Lower: Seal Class B.
  3. Unconditioned Space, Exhaust Ducts: Seal Class C.
  4. Unconditioned Space, Return-Air Ducts: Seal Class B.
  5. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-inch wg and Lower: Seal Class C.
  6. Conditioned Space, Exhaust Ducts: Seal Class B.
  7. Conditioned Space, Return-Air Ducts: Seal Class C.

### **3.04 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1M, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 ft.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### **3.05 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.06 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 Painting Sections.

### **3.07 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 2. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
  - 3. Test for leaks before applying external insulation.
  - 4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 5. Give 7 days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.08 DUCT CLEANING**

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use duct cleaning methodology as indicated in NADCA ACR.
- C. Use service openings for entry and inspection.
  - 1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and



- cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  3. Remove and reinstall ceiling to gain access during the cleaning process.
- D. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- E. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and condensate collectors and drains.
  4. Coils and related components.
  5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  6. Supply-air ducts, dampers, actuators, and turning vanes.
- F. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  6. Provide drainage and cleanup for wash-down procedures.
  7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

### **3.09 STARTUP**

- A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

### **3.10 DUCT SCHEDULE**

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive 1-inch wg.

- b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12 .
  - 2. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  - 3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round: 6.
- C. Return Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12
    - d. SMACNA Leakage Class for Round: 12.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: B
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  - 3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
- D. Exhaust Ducts:
  - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 12.
  - 3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: B.

- c. SMACNA Leakage Class for Rectangular: 12.
  - d. SMACNA Leakage Class for Round: 12.
- F. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Liner:
  - 1. Supply Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1-1/2 inches thick.
  - 2. Return Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1-1/2 inches thick.
  - 3. Exhaust Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inch thick.
  - 4. Supply Fan Plenums: Fibrous glass, Type II or Flexible elastomeric, 1-1/2 inches thick.
  - 5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II or Flexible elastomeric, 2 inches thick.
  - 6. Transfer Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inch thick.
- H. Elbow Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 without vanes.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
  - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
  - 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      - 2) Velocity 1000 fpm to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      - 4) Radius-to Diameter Ratio: 1.5.
    - b. Round Elbows, 12 inches and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 inches and Larger in Diameter: Standing seam or Welded.
- I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 fpm to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

**END OF SECTION**

**SECTION 23 33 00  
AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Manual volume dampers.
  - 2. Flexible connectors.

**PART 2 PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

**2.02 MANUAL VOLUME DAMPERS**

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.
    - c. Flexmaster U.S.A., Inc.
    - d. McGill AirFlow LLC.
    - e. Nailor Industries Inc.
    - f. Pottorff.
    - g. Ruskin Company.
    - h. Trox USA Inc.
    - i. Vent Products Company, Inc.
  - 2. Standard leakage rating, with linkage outside airstream.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized steel, 0.064 inch thick.
  - 6. Blade Axles: Galvanized steel.
  - 7. Bearings:
    - a. Molded synthetic.

- b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Tie Bars and Brackets: Galvanized steel.

## **2.03 FLEXIBLE CONNECTORS**

- A. Manufacturers:
  - 1. Ventaire.
  - 2. Z-Flex.
  - 3. Ductmate Industries, Inc.
- 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 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Select metal compatible with ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz/sq. yd.
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install flexible connectors to connect ducts to equipment.
- I. Install duct test holes where required for testing and balancing purposes.

### **3.01 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
  - 3. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION**

## **SECTION 23 33 46 FLEXIBLE DUCTS**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Insulated flexible ducts.

#### **1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations and mounting and attachment details.

### **PART 2 - PRODUCTS**

#### **2.01 ASSEMBLY DESCRIPTION**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

#### **2.02 INSULATED FLEXIBLE DUCTS**

- A. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
  - 4. Insulation R-Value: Comply with ASHRAE/IES 9s0.1.
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 175 deg F.
  - 4. Insulation R-Value: Comply with ASHRAE/IES 90.1
- C. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.



2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts with maximum 10'-0" lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect flexible ducts to metal ducts with draw bands.
- E. Install duct test holes where required for testing and balancing purposes.
- F. Installation:
  1. Install ducts fully extended.
  2. Do not bend ducts across sharp corners.
  3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  5. Install flexible ducts in a direct line, without sags, twists, or turns.
- G. Supporting Flexible Ducts:
  1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
  2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
  3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
  4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

### **END OF SECTION**

**SECTION 23 34 23**  
**HVAC POWER VENTILATORS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Ceiling-mounted ventilators.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
  - 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
  - 3. Certified fan performance curves with system operating conditions indicated.
  - 4. Certified fan sound-power ratings.
  - 5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 6. Material thickness and finishes, including color charts.
  - 7. Dampers, including housings, linkages, and operators.
  - 8. Prefabricated roof curbs.
  - 9. Fan speed controllers.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

**1.05 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.

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## **2.02 CEILING-MOUNTED VENTILATORS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.
- D. Back-draft damper: Integral.
- E. Grille: Plastic or painted aluminum, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories:
  - 1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  - 3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
  - 4. Motion Sensor: Motion detector with adjustable shutoff timer.
  - 5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless steel springs, and fusible link.
  - 6. Filter: Washable aluminum to fit between fan and grille.
  - 7. Isolation: Spring Hanger Vibration Isolators.
  - 8. Manufacturer's standard roof jack or wall cap, and transition fittings.

## **2.03 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors.
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## **2.04 SOURCE QUALITY CONTROL**

- A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
- B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
- C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION, GENERAL**

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
  - 1. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Install units with clearances for service and maintenance.

### **3.02 DUCTWORK CONNECTIONS**

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

### **3.03 ELECTRICAL CONNECTIONS**

- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

### **3.04 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.

### **3.05 STARTUP SERVICE:**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. 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.
  - 4. Verify that cleaning and adjusting are complete.
  - 5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Remove and replace malfunctioning units and retest as specified above.

### **3.06 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Lubricate bearings.
- C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

### **3.07 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

### **3.08 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

## **END OF SECTION**

**SECTION 23 37 13.13**  
**AIR DIFFUSERS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Rectangular and square ceiling diffusers.
  - 2. Louver face diffusers.
- B. Related Requirements:
  - 1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
  - 2. Section 23 37 13.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

**PART 2 - PRODUCTS**

**2.01 RECTANGULAR AND SQUARE CEILING DIFFUSERS**

- A. Manufacturers: As indicated on drawings.
- B. Material: As indicated on drawings.
- C. Finish: Color selected by Architect.
- D. Face Size: As indicated on drawings.
- E. Face Style: As indicated on drawings.
- F. Mounting: Refer to Architectural ceiling plan for exact mounting type.
- G. Dampers: Opposed blade.

**2.02 LOUVER FACE DIFFUSERS**

- A. Manufacturers: As indicated on drawings.
- B. Material: As indicated on drawings.
- C. Finish: Color selected by Architect.
- D. Face Size: As indicated on drawings.
- E. Mounting: Refer to Architectural ceiling plan for exact mounting type.
- F. Dampers: Opposed blade.
- G. Accessories:

1. Square to round neck adaptor.
2. Adjustable pattern vanes.
3. Throw reducing vanes.
4. Equalizing grid.
5. Plaster ring.
6. Safety chain.
7. Wire guard.
8. Sectorizing baffles.
9. Operating rod extension.

## **2.03 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### **3.03 ADJUSTING**

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION**

**SECTION 23 37 23**  
**HVAC GRAVITY VENTILATORS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Hooded ventilators.

**1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For gravity ventilators.
  - 1. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
  - 2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
- C. Samples: For each exposed product and for each color and texture specified.

**1.03 COORDINATION**

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

**PART 2 - PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- B. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
- D. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

**2.02 FABRICATION**

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

## **2.03 HOODED VENTILATORS**

- A. Description: Hooded round penthouse for intake and relief air.
- B. Construction:
  - 1. Material, Aluminum: Thickness required to comply with structural performance requirements, but not less than 0.063-inch-thick base and 0.050-inch-thick hood; suitably reinforced.
  - 2. Bird Screening: Aluminum, 1/2-inch-square mesh or flattened, expanded aluminum, 3/4-inch diamond mesh wire.
- C. Galvanized-Steel Finish:
  - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas, and repair galvanizing according to ASTM A780/A780M. Apply a conversion coating suited to the organic coating to be applied over it.
- D. Dampers:
  - 1. Location: Hood neck.
  - 2. Tray: Provide damper tray or shelf with opening 3 inches of size indicated.
- E. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
  - 1. Overall Height: 12 inches.

## **2.04 SOURCE QUALITY CONTROL**

- A. AMCA Certification for Hooded Ventilators: Test, rate, and label gravity ventilators in accordance with AMCA 511.

## **2.05 MATERIALS**

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating, mill phosphatized.
- D. Stainless-Steel Sheet: ASTM A666, Type 304, with No. 4 finish.
- E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
  - 1. Use types and sizes to suit unit installation conditions.
  - 2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
- F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION, GENERAL**

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure gravity ventilators to roof curbs with zinc-plated hardware. Use concealed anchorages where possible. Refer to Section 07 72 00 "Roof Accessories."



- C. Install gravity ventilators with clearances for service and maintenance.
- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during installation.
- F. Label gravity ventilators according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes, so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- I. Refer to Section 07 72 00 "Roof Accessories" for flashing and counterflashing of roof curbs.

### **3.02 DUCT CONNECTIONS**

- A. Duct installation and connection requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

**END OF SECTION**

**SECTION 23 81 26**  
**SPLIT-SYSTEM AIR-CONDITIONERS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

**1.05 MAINTENANCE MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set for each air-handling unit.
  - 2. Gaskets: One set for each access door.
  - 3. Fan Belts: One set for each air-handling unit fan.

**1.06 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

## **1.07 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

## **1.08 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: Five year(s) from date of Substantial Completion.
    - c. For Labor: One year from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: As indicated on drawings.

### **2.02 INDOOR UNITS**

- A. Floor-Mounted, Evaporator-Fan Components:
  - 1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
    - a. Discharge Grille: Steel with surface-mounted frame or Welded steel bars forming a linear grille and welded into supporting panel.
    - b. Insulation: Faced, glass-fiber duct liner.
    - c. Drain Pans: Galvanized steel, with connection for drain; insulated.
  - 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  - 3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
  - 4. Fan: Direct drive
  - 5. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
  - 6. Air Filtration Section:
    - a. General Requirements for Air Filtration Section:
      - 1) Comply with NFPA 90A.
      - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
      - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
    - b. Disposable Panel Filters:
      - 1) Factory-fabricated, viscous-coated, flat-panel type.
      - 2) Merv according to ASHRAE 52.2: 5.
      - 3) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

## **2.03 OUTDOOR UNITS**

- A. Air-Cooled, Compressor-Condenser Components:
  - 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
  - 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
    - a. Compressor Type: Scroll.
    - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    - c. Refrigerant Charge: R-454B.
    - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
  - 3. Fan: Aluminum-propeller type, directly connected to motor.
  - 4. Motor: Permanently lubricated, with integral thermal-overload protection.
  - 5. Low Ambient Kit: Permits operation down to 45 deg F.
  - 6. Mounting Base: Polyethylene.

## **2.04 ACCESSORIES**

- A. Thermostat:
  - 1. Compressor time delay.
  - 2. 24-hour time control of system stop and start.
  - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  - 4. Fan-speed selection including auto setting.
  - 5. Controls that, except during defrost, prevent supplementary heat operation where the heat pump can provide the heating load.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
  - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### **3.02 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

- C. Duct Connections: Duct installation requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 23 33 00 "Air Duct Accessories."

### **3.03 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### **3.04 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### **3.05 DEMONSTRATION**

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

**END OF SECTION**

**SECTION 23 82 39.19**  
**WALL AND CEILING UNIT HEATERS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include details of anchorages and attachments to structure and to supported equipment.
  - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Wiring Diagrams: Power, signal, and control wiring.

**1.3 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

**2.2 DESCRIPTION**

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

**2.3 CABINET**

- A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

**2.4 COIL**

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

**SECTION 23 82 39.19**  
**WALL AND CEILING UNIT HEATERS**

**2.5 FAN AND MOTOR**

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated.

**2.6 CONTROLS**

- A. Controls: Unit-mounted thermostat.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

**END OF SECTION**

**SECTION 26 05 00**  
**GENERAL PROVISIONS FOR ELECTRICAL WORK**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. The work included in this Contract is shown on the drawings and described in these specifications. It consists of furnishing all labor, material, services, supervision and connection of all systems shown and/or specified including the requirements of:
  - 1. Division 00 – Bidding and Contract Requirements.
  - 2. Division 01 – General Requirements.
  - 3. Division 26 – Electrical Work.
- B. Contractor is responsible to review and understand all drawings and all work of all trades to ensure a complete and thorough project.
- C. Provide all labor, tools, materials, equipment, coordination, and plans necessary for installation and proper operation of the electrical systems.
- D. Contract drawings and specifications are complementary and must be so used to ascertain all requirements of the work.

**1.02 DEFINITIONS**

- A. Provide, furnish, install, and furnish and install shall have the same meaning. That is, the Contractor shall purchase, transport to the site and install all required components of the work unless specifically stated otherwise in the contract documents.
- B. Wiring pertains to raceway, fittings, conductors, terminations, hangers, supports, etc. as required to form a complete system.

**1.03 DRAWINGS AND SPECIFICATIONS**

- A. The plans are diagrammatic and indicate only the sizes and general arrangement of conduit, devices, and equipment; exact locations of all elements shall be determined as work progresses, in cooperation with the work of other trades. It is not intended to show every item of work or minor piece of equipment, but every item shall be furnished and installed without additional remuneration as necessary to complete the system in accordance with the best practice of the trade.
- B. As previously stated, the exact locations of electrical devices and equipment are diagrammatic. The owner may request for any devices or equipment to be installed at different locations than what is indicated on the drawings in a specific area or room. It is the responsibility of the Electrical Contractor to coordinate the locations of devices in all areas prior to installation.

**1.04 APPLICABLE STANDARDS**

- A. All equipment shall bear the UL label.
- B. The latest edition of the following minimum standards shall apply wherever applicable:
  - 1. ASA American Standards Association
  - 2. ASTM American Society for Testing Materials
  - 3. ETL Electrical Testing Laboratories, Inc.
  - 4. IEEE Institute of Electrical and Electronic Engineers
  - 5. IPCEA Insulated Power Cable for Engineers Association
  - 6. OSHA Occupational Safety and Health Act
  - 7. NEC National Electrical Code
  - 8. NEMA National Electrical Manufacturers Association



9. NESC National Electrical Safety Code
10. NFPA National Fire Protection Association
11. UL Underwriters Laboratories, Inc.
12. Power company standards and regulations.
13. Local and state codes.

C. In the event there are conflicts between specifications and standards, standards shall govern unless specifications are in excess of standards.

#### **1.05 PERMITS AND INSPECTIONS**

- A. Permits: The Contractor shall apply for and pay the cost for any local permits necessary for the work of this contract.
- B. Inspections: The Contractor shall be responsible for obtaining all electrical inspections of and the certificate by the approved inspection authority having jurisdiction for the entire electrical system.
- C. The undertaking of periodic inspections by the Owner or Engineer shall not be construed as supervision of actual construction. The Owner or Engineer is not responsible for providing a safe place of work for the Contractor, Contractor's employees, suppliers or subcontractors for access, visits, use, work, travel or occupancy by any person.

#### **1.06 CODES AND REGULATIONS**

- A. Comply with all applicable rules and regulations of the municipal laws and ordinances and latest revisions thereof. All work shall be done in full conformity with the requirements of all authorities having jurisdiction. Modifications required by the above authorities will be made without additional charges to the Owner. Where alterations to and/or deviations from the Contract Documents are required by the authorities, report the requirements to the Engineer and secure approval before work is started.
- B. Furnish and file with the proper authorities, all drawings required by them in connection with the work. Obtain all permits, licenses, and inspections and pay all legal and proper fees and charges in this connection.
- C. Should any work shown or specified be of lighter or smaller material than Code requires, same shall be executed in strict accordance with the regulations.
- D. Heavier or larger size material than Code requires shall be furnished and installed, if required by the Plans and Specifications.
- E. This Contractor shall have the electrical work inspected from time to time by authorized inspectors. At the completion of the work, the Contractor shall furnish a Certificate of Approval, in triplicate, indicating full approval of the work furnished and installed in this Contract from the local authority having jurisdiction.
- F. Equipment and components parts thereof shall bear manufacturer's nameplate, giving manufacturer's name, size, type and model number or serial number, electrical characteristic to facilitate maintenance and replacements. Nameplates of distributors or contractors are not acceptable.
- G. Engineer will have privilege of stopping any work or use of any material that in his opinion is not being properly installed and each Contractor shall remove all materials delivered, or work erected, which does not comply with Contract Drawings and Specifications, and replace with proper materials, or correct such work as directed by the Engineer, at no additional cost to Owner.
- H. If equipment or materials are installed before proper approvals have been obtained, each Contractor shall be liable for their removal and replacement including work of other trades affected by such work, at no additional cost to Owner, if such items do not meet intent of the Drawings and Specifications.

### **1.07 RECORD DRAWINGS**

- A. The Electrical Contractor shall keep an accurate location record of all underground and concealed piping, and of all changes from the original design. He is required to furnish this information to the Engineer prior to his application for final payment.
  - 1. Submit prior to final acceptance inspection, one complete marked-up set of reproducible engineering design drawings in PDF format.
    - a. Fully illustrate all revisions made by all crafts in course of work.
    - b. Include all field changes, adjustments, variances, substitutions and deletions, including all Change Orders.
    - c. Exact location of raceways, equipment and devices.
    - d. Exact size and location of underground and under floor raceways and duct banks.
  - 2. These drawings shall be for record purposes for Owner's use and are not considered shop drawings.
- B. At completion of the project, all changes and deviations from the Contract Documents shall be recorded by the Contractor.
- C. Four (4) corrected sets of all operating and maintenance instructions and complete parts lists bound in hard covers and in PDF format shall be furnished to the Owner.

### **1.08 SLEEVES**

- A. Sleeves: furnished, set in Electrical Work; built-in under General Construction Work.
- B. Sleeves shall be as follows:
  - 1. Sleeves in floors and partitions shall be galvanized steel with lock seam joints or a manufactured conduit floor seal.
  - 2. Sleeves of extra heavy cast iron pipe or galvanized steel pipe shall be used in outside walls, foundations, and footing or manufactured compression-type wall seal (waterproof).
  - 3. Conduit sleeves shall be two (2) sizes larger than the conduit passing through it.
  - 4. Terminate sleeves flush with walls, partitions, and ceilings. Sleeves in floor shall terminate 1/4" above floors.
  - 5. Fill space between sleeve and conduit in foundation walls with oakum and caulk with lead on both sides of wall. When using pipe sleeves, fill space between sleeve and pipe with fiberglass blanket insulation when sleeve does not occur in a foundation wall.
  - 6. An approved fire stop seal shall be used when conduits penetrate fire stopping walls and floors (between fire zones).
- C. Set sleeves and obtain review of their locations in ample time to permit pouring of concrete or progressing of other construction work as scheduled.

### **1.09 CLEANING CONDUIT, EQUIPMENT**

- A. Conduit, equipment: thoroughly cleaned of dirt, cuttings, other foreign substances. Should any conduit, other part of systems be stopped by any foreign matter, disconnect, clean wherever necessary for purpose of locating, removing obstructions. Repair work damaged in course of removing obstructions.

### **1.010 VIBRATION ISOLATION**

- A. Vibration isolators shall prevent, as far as practicable, transmission of vibration, noise or hum to any part of building.
- B. Design isolators to suit vibration frequency to be absorbed; provide isolator units of area, distribution to obtain proper resiliency under machinery load, impact.

- C. Wiring and other electrical connections to equipment mounted on vibration isolators; made flexible with minimum 180 degree loop of "greenfield" in order to avoid restraining equipment and short circuiting vibration isolator.

#### **1.011 BALANCED LOAD**

- A. It is intended that design and features of the work as indicated will provide balanced load on the feeders and main service. Contractor shall provide material and installation to provide this balance load insofar as possible.
- B. Contractor shall take current and voltage measurements at all panels of at least 1/2 hour. Reconnections of loads shall be made when deemed necessary by the Engineer or when required to comply with adjusting requirements of Section 262416 "Panelboards."

#### **1.012 JOB CONDITIONS**

- A. Examine site related work and surfaces before starting work of any Section. Failure to do so shall in no way relieve the Contractor of the responsibility to properly install the new work.
  - 1. Report to the Engineer, in writing, conditions which will prevent proper provision of this work ten (10) days prior to bid date, in time for an addendum to be issued.
  - 2. Beginning work of any Section without reporting unsuitable conditions to the Engineer constitutes acceptance of conditions by the Contractor.
  - 3. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to Owner.
  - 4. The Contractor is responsible for performing routine maintenance and cleaning of any existing equipment where he is making connections to new work and to the building where his work adds debris.

#### **1.013 SPECIAL TOOLS AND LOOSE ITEMS**

- A. Furnish to Owner at completion of work:
  - 1. One set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of this Division.
  - 2. "Special Tools": Those not normally found in possession of mechanics or maintenance personnel.
  - 3. Keys
  - 4. Redundant components and spare parts.
- B. Deliver items to Owner and obtain receipt prior to approval of final payment.

#### **1.014 REVIEW OF CONSTRUCTION**

- A. Work may be reviewed at any time by representative of the Engineer.
- B. Advise Architect and Engineer that work is ready for review at following times:
  - 1. Prior to backfilling buried work.
  - 2. Prior to concealment of work in walls and above ceilings.
  - 3. When all requirements of contract have been completed.
- C. Neither backfill nor conceal work without Engineer's consent.

#### **1.015 SHOP DRAWING SUBMITTALS**

- A. Submit required shop drawings, samples and product information in accordance with Division 01 requirements and as required in the various sections of these specifications.
- B. Submittals shall show evidence of checking by the Contractor for accuracy. Product information (catalog sheets) shall indicate complete catalog number, color, accessories, etc., as well as name of manufacturer and local distributor or manufacturer's representative.

C. Incomplete submittals will be rejected.

D. Additionally, the Contractor will submit data on the following:

1. All electrical equipment including all panelboards and switching devices (disconnects, switches, occupancy sensors, etc.); refer to submittal requirements of each section.
2. Any proposed variation in specified wiring plans and circuitry.
3. All special items and panels, made or constructed specifically for this project, including wiring diagrams, component layout and component data or materials list.
4. All settings of installed equipment, such as overcurrent protection, overload settings, temperature settings, time settings, etc. This includes equipment provided by other contractors or subcontractors and connected and tested by this Contractor.

E. All submittals of NON-SPECIFIED equipment and components will be reviewed. It is the submitting Contractor's responsibility to prove compliance and not the Architect/Engineer to prove non-compliance. The submitting Contractor will be charged the prevailing wage of the reviewing Engineer for all submittals requiring over one (1) hour to review that were not originally specified.

F. It is the Contractor's responsibility to provide submittals in an organized and timely manner so as not to delay the project schedule and hamper the work of other trades.

#### **1.016 OPERATING INSTRUCTIONS**

A. It shall be the Contractor's responsibility to ensure that the Owner's representative is given adequate instruction on the operation of all equipment prior to final payment.

#### **1.017 TEMPORARY POWER**

A. The Contractor shall coordinate all temporary power to all trades throughout all phases of construction throughout the duration of this project with the construction manager. This will include but not be limited to temporary lighting, power outlets, temporary elevator operation, controls for temporary heating, and job trailers. Contractor shall be responsible for coordinating temporary power via adjacent building(s) and/or a temporary diesel fired generator and associated fuel costs. Contractor shall coordinate temporary power source with construction manager prior to demolition. Contractor is responsible for all costs associated with temporary power.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. All materials and equipment shall be new and as specified or of equal or better quality.
- B. Basic hardware and miscellaneous items shall meet existing trade standards of quality and shall carry UL or FM listings where applicable.
- C. All equipment supplied shall be the standard equipment of the manufacturer.
- D. Multiple items such as raceways, wiring devices, etc., shall be from the same manufacturer.
- E. Drawings and specifications are based on specific manufacturer's equipment. Therefore, the Contractor shall assume all responsibility, cost and coordination involved in making any necessary revisions to apply another manufacturer's equipment, even though it may be approved as an "equal" item by the Engineer.

## **PART 3 - EXECUTION**

### **3.01 COORDINATION OF WORK**

- A. All work shall be executed in accordance with recognized standards of workmanship. All work shall be installed in a neat and orderly manner.
- B. The Contractor shall exchange information with other Contractors and the Owner in order to ensure orderly progress of the work.
- C. The Contractor must contact the Owner's representative and schedule all work ten (10) days prior to start.
- D. The Contractor shall check for possible interference before installing any items. If any work is installed, and later develops interference with other features of the design, the Contractor will be responsible for making such changes to eliminate the interference.

**END OF SECTION**

**SECTION 26 05 19**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

**1.03 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

**1.04 ACTION SUBMITTALS**

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

**1.05 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

**PART 2 - PRODUCTS**

**2.01 CONDUCTORS AND CABLES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
  - 6. Encore Wire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

## **2.02 CONNECTORS AND SPLICES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## **PART 3 - EXECUTION**

### **3.01 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### **3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- B. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway. Armored Cable Type AC may be used only for whips to lighting fixtures above accessible ceilings; whips limited to 6 feet long.
- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### **3.03 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. For stranded conductors, install crimp on fork terminals for device terminations if device does not have pressure terminals. Do not place bare stranded conductors directly under screws unless device has pressure terminals.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems".
- G. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems".

### **3.04 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior wall assemblies. Comply with requirements in Section 260500 "General Provisions for Electrical Work".

### **3.05 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### **3.06 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to an approved UL-listed method.

### **3.07 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace malfunctioning units and retest as specified above.

**END OF SECTION**



**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes: Grounding systems and equipment.

**1.03 ACTION SUBMITTALS**

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

**1.04 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Ground rods, grounding bars, grounding clamps, and accessories:
  - 1. Erico.
  - 2. Harger.
  - 3. Southern Grounding.
  - 4. Galvan.
- B. Exothermic welding systems:
  - 1. Cadweld.
  - 2. Thermoweld.
  - 3. Ultrashot.

**2.02 CONDUCTORS**

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Sizes and types of conductors in four subparagraphs below are typical examples. 28-kcmil bonding cable in first subparagraph is slightly larger than No. 6 AWG.
  - 5. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 6. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 7. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

8. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

## **2.03 CONNECTORS**

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## **2.04 GROUNDING ELECTRODES**

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet in diameter.

# **PART 3 - EXECUTION**

## **3.01 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, size as shown on Drawings minimum.
  1. Bury at least 30 inches below grade.
- C. Conductor Terminations and Connections:
  1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Exothermically welded connectors except as otherwise indicated.
  3. Connections to Structural Steel: Exothermically welded connectors.

## **3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

- A. Comply with IEEE C2 grounding requirements.
- B. Install two parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds maximum resistance specified herein.

## **3.03 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

### 3.04 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Where metal duct is directly connected to unit, check continuity and bond as required. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

### 3.05 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

### 3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Electrical Service Disconnect: 15 ohms.
  2. Transformers: 5 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION**

**SECTION 26 05 29**  
**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.

**1.03 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

**1.04 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

**1.05 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Steel slotted support systems.

**1.06 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

**1.07 COORDINATION**

- A. Coordinate installation of equipment supports.

**PART 2 - PRODUCTS**

**2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

## **2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## **PART 3 - EXECUTION**

### **3.01 APPLICATION**

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### **3.02 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To New Concrete: Bolt to concrete inserts.
  2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  3. To Existing Concrete: Expansion anchor fasteners.
  4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts and Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  6. To Light Steel: Sheet metal screws.
  7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount pull and junction boxes, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### **3.03 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### **3.04 PAINTING**

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 Section "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**



**SECTION 26 05 33**  
**RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Nonmetal conduits, tubing, and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Boxes.
  - 5. Outdoor receptacle pedestals and ground boxes.

**1.03 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit (galvanized steel).
- C. FMC: Flexible metal conduit.
- D. LFMC: Liquid-tight flexible metal conduit.

**1.04 ACTION SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor, wall, and ceiling A/V boxes.

**PART 2 - PRODUCTS**

**2.01 METAL CONDUITS, TUBING, AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Anamet Electrical, Inc.
  - 4. Electri-Flex Company.
  - 5. O-Z/Gedney; a brand of EGS Electrical Group.
  - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
  - 7. Republic Conduit.
  - 8. Robroy Industries.
  - 9. Southwire Company.
  - 10. Thomas & Betts Corporation.
  - 11. Western Tube and Conduit Corporation.
  - 12. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. RMC: Comply with ANSI C80.1 and UL 6.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. FMC: Comply with UL 1; zinc-coated steel
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
  
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Compression.
  - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- H. Joint Compound for RMC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## **2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Anamet Electrical, Inc.
  - 3. Arnco Corporation.
  - 4. CANTEX Inc.
  - 5. CertainTeed Corp.
  - 6. Condux International, Inc.
  - 7. Electri-Flex Company.
  - 8. Kraloy.
  - 9. Lamson & Sessions; Carlon Electrical Products.
  - 10. Niedax-Kleinhuis USA, Inc.
  - 11. RACO; a Hubbell company.
  - 12. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. PVC: Type EPC-40-PVC and 80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Fittings for PVC: Comply with NEMA TC 3; match to conduit or tubing type and material.

## **2.03 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.06 BOXES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Adalet .
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman; a Pentair company.
  - 7. Hubbell Incorporated; Killark Division.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. Mono-Systems, Inc.
  - 11. O-Z/Gedney; a brand of EGS Electrical Group.
  - 12. RACO; a Hubbell Company.
  - 13. Robroy Industries.
  - 14. Spring City Electrical Manufacturing Company.
  - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  - 16. Thomas & Betts Corporation.
  - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Floor, Wall, and Ceiling A/V Boxes: refer to applicable specification section.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
  - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep unless otherwise noted.
- M. Gangable boxes are allowed.

## **2.07 OUTDOOR RECEPTACLE PEDESTALS AND GROUND BOXES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1. Legrand.
    - 2. Hubbell.
    - 3. Pedoc.
    - 4. Leviton.
  - B. General: Outdoor ground boxes and pedestals shall be listed for use in wet locations.
  - C. Outdoor Ground Boxes and Pedestals: Comply with requirements of applicable local codes, NEC, UL, CSA, and NEMA Standards pertaining to outdoor floor boxes. Tested and listed by Underwriters Laboratories, Inc. to meet NEMA 6P and IP68 requirements for use in outdoor locations. Outdoor ground boxes and pedestals shall comply with ADA guidelines including unobstructed reach requirements.
- C. See Drawings for specific requirements.

## **PART 3 - EXECUTION**

### **3.01 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: RMC.
  - 2. Concealed Conduit, Aboveground: RMC.
  - 3. Underground Conduit: PVC, Type EPC-40-PVC.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage (above 8'-0" AFF): EMT.
  - 3. Exposed and Subject to Severe Physical Damage (below 8'-0" AFF): RMC.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Damp or Wet Locations: RMC.
  - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use compression, expansion gland type, steel fittings. Comply with NEMA FB 2.10.
  - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### **3.02 INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.

### **3.03 RACEWAYS EMBEDDED IN SLABS**

- A. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
- B. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- C. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
- D. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- E. Change from PVC to EMT before rising above floor within walls, change from PVC to RMC at all other locations.
- F. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- I. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
  - 6. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

7. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- J. Cut conduit perpendicular to the length required. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- M. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- N. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- O. Comply with manufacturer's written instructions for solvent welding PVC and fittings.
- P. Expansion-Joint Fittings:
  1. Install in each run of aboveground PVC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Q. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC in damp or wet locations not subject to severe physical damage.
  3. Flexible Conduit Connections for vibration isolation: Provide connections as follows:
    - a. For conduit greater than 1" O.D., make electrical connections to vibrating equipment via a flexible expansion/deflection conduit coupling. Coupling shall have flexible and watertight outer jacket, internal grounding strap, plastic inner sleeve to maintain smooth wireway, and end hubs with threads to fit standard threaded metal conduit.
    - b. For conduit less than 1" O.D., utilize flexible conduit with slack shape or provide a flexible coupling as defined above. Install flexible conduit in a 360° slack loop or in a "U" shape with a depth of the U shape equal to 20 times the diameter of the conduit. Conduit slack shapes must not exceed manufacturer's recommended minimum

bending radius and the metal corrugations must not bind against one another and thus provide a rigid vibration path.

- R. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- S. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- T. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- U. Sound Insulating Partitions: Where individual back boxes are installed on either side of a sound insulating partition, the boxes shall be staggered a minimum of 2 feet. Back boxes shall be covered with either a fire or sound putty pad.
- V. Locate boxes so that cover or plate will not span different building finishes.
- W. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- X. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Y. Set metal floor boxes level and flush with finished floor surface.

#### **3.04 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 00 "General Provisions for Electrical Work."

#### **3.05 FIRESTOPPING**

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies using an approved UL-listed method.

#### **3.06 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

**SECTION 26 05 43**  
**UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Install underground power and signal system feeder conduits outside foundation line as specified or as shown. This shall include, but not be limited to, all excavation, draining trenches, sloping of conduit, backfilling, compacting, and removal of excess dirt.

**1.03 DEFINITION**

- A. RNC: Rigid nonmetallic conduit.

**1.04 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Duct-bank materials, including separators and miscellaneous components.
  - 2. Conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Handholes, boxes, and their accessories.
  - 4. Warning tape.
- B. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.
  - 2. Cover design.
  - 3. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

**1.05 QUALITY ASSURANCE**

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

**1.07 PROJECT CONDITIONS**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Owner no fewer than 30 days in advance of proposed interruption of electrical service.



2. Do not proceed with interruption of electrical service without Owner's written permission.

## **1.08 COORDINATION**

- A. Coordinate layout and installation of ducts, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into handholes and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to handholes, and as approved by Architect.

## **PART 2 - PRODUCTS**

### **2.01 CONDUIT**

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

### **2.02 DUCT ACCESSORIES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. ARNCO Corp.
  2. Beck Manufacturing.
  3. Cantex, Inc.
  4. CertainTeed Corp.; Pipe & Plastics Group.
  5. Condux International, Inc.
  6. ElecSys, Inc.
  7. Electri-Flex Company.
  8. IPEX Inc .
  9. Lamson & Sessions; Carlon Electrical Products.
  10. Manhattan/CDT; a division of Cable Design Technologies.
  11. Spiraduct/AFC Cable Systems, Inc.
- B. Duct Accessories:
  1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
  2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

### **2.03 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE**

- A. Description: Comply with SCTE 77.
  1. Color: Gray.
  2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
  3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

- a. For Town Square project, provide custom galvanized steel cover with tray to accept surrounding hardscape material.
- 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- 5. Cover Legend: Molded lettering, as indicated for each service.
- 6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- 7. Handholes 24 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Quazite
    - b. Armorcast Products Company.
    - c. Carson Industries LLC.
    - d. CDR Systems Corporation.
    - e. New Basis.
    - f. WunderCovers.

## **2.04 SOURCE QUALITY CONTROL**

- A. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  - 2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## **PART 3 - EXECUTION**

### **3.01 UNDERGROUND DUCT APPLICATION**

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- C. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- D. Underground Ducts Crossing Driveways, Roadways, and Railroads: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank.

### **3.02 UNDERGROUND ENCLOSURE APPLICATION**

- A. Handholes and Boxes for 600 V and Less, including Telephone, Communications, and Data wiring:

1. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
2. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
3. Cover design load shall not exceed the design load of the handhole or box.

### **3.03 EARTHWORK**

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 specifications.
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Section 017329 "Cutting and Patching."

### **3.04 DUCT INSTALLATION**

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
  1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
  2. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in 260500 "General Provisions for Electrical Work."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf-test nylon cord in empty ducts.
- H. Concrete-Encased Ducts:
  1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches in nominal diameter.
  2. Width: Excavate trench 3 inches wider than duct bank on each side.

3. Depth: Comply with NFPA 70.
4. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
5. Separator Installation: Support ducts on duct separators. Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
7. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
  - a. Couple steel conduits to ducts with adapters designed for this purpose.
  - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
  - c. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  - d. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
    - 1) Concrete Cover: Install a minimum of 3 inches of concrete cover at top and bottom, and a minimum of 2 inches on each side of duct bank.
    - 2) Concreting Sequence: Pour each run of envelope between handholes or other terminations in one continuous operation.
      - (a) Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
      - (b) If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
  - e. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
8. Direct-Buried Duct Banks:
  - a. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
  - b. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  - c. Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to

expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

- d. Depth: Comply with NFPA 70.
- e. Set elevation of bottom of duct bank below frost line.
- f. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
- g. Elbows: Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
  - 1) Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - 2) For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
  - 3) After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
    - (a) Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
    - (b) Place minimum 6 inches of engineered fill above concrete encasement of duct bank.
- I. Warning Tape: Bury warning tape approximately 12 inches above all concrete-covered ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

### **3.05 INSTALLATION OF HANDHOLES AND BOXES**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line, below grade.
- E. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- F. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, provide concrete or other structural protection as directed by manufacturer of enclosure.

- G. For Town Square project, provide custom galvanized steel cover with tray to accept surrounding hardscape material. Coordinate with architectural and civil drawings for hardscape material to match.

### **3.06 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections and prepare test reports:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Provide suitable caps to protect installed conduit against entrance of dirt and moisture.

### **3.07 CLEANING**

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

**END OF SECTION**

**SECTION 26 05 53**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Identification for wiring devices.
  - 5. Underground-line warning tape.
  - 6. Equipment identification labels.
  - 7. Miscellaneous identification products.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each electrical identification product indicated.

**1.04 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

**1.05 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

**PART 2 - PRODUCTS**

**2.01 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

- B. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

## **2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

## **2.03 CONDUCTOR IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

## **2.04 WIRING DEVICE LABELS**

- A. Embossed adhesive tape, with ¼-inch black-filled letters on clear background.

## **2.05 UNDERGROUND-LINE WARNING TAPE**

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.



3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
1. Comply with ANSI Z535.1 through ANSI Z535.5.
  2. Inscriptions for Yellow-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
  3. Inscriptions for Orange-Colored Tapes: COMMUNICATIONS AND SIGNAL CABLES.
- C. Type:
1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  2. Overall Thickness: 8 mils.
  3. Foil Core Thickness: 0.35 mil.
  4. Weight: 34 lb/1000 sq. ft.
  5. 3-Inch Tensile According to ASTM D 882: 300 lbf, and 12,500 psi.

## **2.06 EQUIPMENT IDENTIFICATION LABELS**

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed. Minimum letter height shall be 3/8 inch (10 mm). Refer to detail on drawings.

## **2.07 FLOOR MARKING TAPE**

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

## **2.08 CABLE TIES**

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
  5. Color: Black.

## **2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### **3.02 IDENTIFICATION SCHEDULE**

- A. Accessible Conduits and Raceways within Buildings:
  - 1. Identify the covers of each junction and pull box with self-adhesive vinyl labels or permanent marker with the panel and circuit number and system voltage.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 120/240-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.

- c. Neutral conductors shall be White. When two or more neutrals are located in one conduit, individually identify each with the circuit number with which it is associated. Sharing of Neutral Conductors is not permitted.
  - d. Equipment Grounding Conductors:
    - 1) 6 AWG and smaller: Green
    - 2) 4 AWG and larger: Identify with green tape at both ends and at visible points including junction and pull boxes.
  - e. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install wire marker for each conductor at panelboard, gutters, pull boxes, outlet and junctions boxes, and at each load connected. Mark with panel and circuit number.
- E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- F. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual.
- 1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  - 2. Equipment to Be Labeled: Equipment label shall be engraved, laminated acrylic or melamine label. Label all electrical equipment. Refer to Detail on Drawings.
    - a. Label Colors and Contents: Refer to Detail on Drawings.
    - b. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Label with panel name, voltage, and source where fed from. Label each circuit breaker with manufacturer provided circuit number following NEMA standard numbering. Panel directory shall match numbering of breakers.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

## END OF SECTION

**SECTION 26 09 23**  
**LIGHTING CONTROL DEVICES**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Indoor occupancy sensors.
  - 2. Wall-box dimmers.
  - 3. Lighting contactors.
  - 4. Key switches.
- B. Related Requirements:
  - 1. Section 26 27 26 "Wiring Devices" for manual light switches, and color/finish of devices.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
  - 2. Include diagrams for power, signal, and control wiring.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS**

**2.01 INDOOR OCCUPANCY SENSORS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper Industries, Inc.
  - 2. Lightolier Controls.
  - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
  - 4. Lutron Electronics Co., Inc.
  - 5. Sensor Switch, Inc.
  - 6. Square D; a brand of Schneider Electric.
  - 7. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:
  - a. Sensor: Suitable for mounting in any position on a standard outlet box.
  - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  - d. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  - e. Bypass Switch: Override the "on" function in case of sensor failure.
  - f. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
  - g. Dual Relay Units: Shall have provisions for setting both relays to turn on when occupancy is detected. Units that allow only one relay to default to "on" are not acceptable.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
  1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  3. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
  4. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  5. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.04 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Cooper Industries, Inc.
  2. Leviton Mfg. Company Inc.
  3. Lightolier Controls.
  4. Lithonia Lighting; Acuity Lighting Group, Inc.
  5. Lutron Electronics Co., Inc.
  6. Sensor Switch, Inc.
  7. Square D; a brand of Schneider Electric.
  8. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.

3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
4. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
5. Sensing Technology: Dual technology (PIR and ultrasonic).
6. Switch Type: Single-relay or dual-relay, as indicated on drawing.
  - a. Dual-Relay Units: Shall have provisions for setting both relays to turn on when occupancy is detected. Units that allow only one relay to default to "on" are not acceptable.
  - b. Voltage: Match the circuit voltage.
  - c. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  - d. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
  - e. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
  - f. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
  - g. Color/finish shall match that of other wiring devices in the project.

## 2.05 WALL-BOX DIMMERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Cooper Industries, Inc.
  2. Leviton Mfg. Company Inc.
  3. Lightolier Controls.
  4. Lithonia Lighting; Acuity Lighting Group, Inc.
  5. Lutron Electronics Co., Inc.
  6. Sensor Switch, Inc.
  7. Watt Stopper.
- B. Dimmer Switches: Specification grade, modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- C. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472. Standard toggle-type switch with small adjacent slider is not acceptable.
- D. Coordinate dimmer type with lighting fixtures being controlled. Provide compatible type of dimmer (e.g., 0-10V, forward phase control, etc.) as required.
- E. Power rating: Match load on drawings; 600 watts minimum.

## 2.06 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Allen-Bradley/Rockwell Automation.
  2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
  3. Eaton Corporation.
  4. General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.
  5. Square D; a brand of Schneider Electric.

- B. Description: Electrically operated and electrically held, combination-type lighting contactors, complying with NEMA ICS 2 and UL 508.
  - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
  - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  - 3. Enclosure: Comply with NEMA 250.
  - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

## **2.07 KEY SWITCHES**

- A. See detail on Drawings for requirements.

## **2.08 CONDUCTORS AND CABLES**

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Sensors: Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Sensors: Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- C. Dimmers:
  - 1. Install dimmers within terms of their listing.
  - 2. Verify that dimmers used for fan speed control are listed for that application.
  - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

### **3.02 WIRING INSTALLATION**

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### **3.03 IDENTIFICATION**

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."

### **3.04 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

### **3.05 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

### **3.06 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

## **END OF SECTION**



**SECTION 26 22 00**  
**LOW-VOLTAGE TRANSFORMERS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

**1.03 ACTION SUBMITTALS**

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

**1.04 INFORMATIONAL SUBMITTALS**

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Systems." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. 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."
  - 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control test reports.

**1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

**1.06 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

#### **1.08 COORDINATION**

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D; Schneider Electric.
  - 2. Eaton.
  - 3. ABB.
  - 4. Siemens.

#### **2.02 GENERAL TRANSFORMER REQUIREMENTS**

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Aluminum.

#### **2.03 DISTRIBUTION TRANSFORMERS**

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2.
  - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
  - 1. Finish Color: Gray.
- E. Taps for Transformers Smaller Than 3 kVA: None.
- F. Taps for Transformers 7.5 to 24 kVA: Two 5 percent tap above and two 5 percent tap below normal full capacity.

- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
  - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
  - 2. Tested according to NEMA TP 2.
- J. Wall and Ceiling Brackets: Manufacturer's standard brackets.
- K. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

## **2.04 IDENTIFICATION DEVICES**

- A. Nameplates: Engraved, laminated nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## **2.05 SOURCE QUALITY CONTROL**

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

# **PART 3 - EXECUTION**

## **3.01 EXAMINATION**

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

## **3.02 INSTALLATION**

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

## **3.03 CONNECTIONS**

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### **3.04 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Remove and replace units that do not pass tests or inspections and retest as specified above.
- C. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### **3.05 ADJUSTING**

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### **3.06 CLEANING**

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**END OF SECTION**

## **SECTION 26 24 16 PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Lighting and appliance branch-circuit panelboards.
  - 2. Event power pedestal assembly ("Event Power Pedestal" as shown on Drawings).

#### **1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include wiring diagrams for power, signal, and control wiring.

#### **1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### **1.05 MAINTENANCE MATERIAL SUBMITTALS**

- C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Two spares for each type of panelboard cabinet lock.
  - 2. Circuit Breakers Including GFCI Types: Two spares for each panelboard.

#### **1.06 QUALITY ASSURANCE**

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

#### **1.08 PROJECT CONDITIONS**

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner no fewer than ten days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Owner's written permission.
  - 3. Comply with NFPA 70E.

#### **1.09 COORDINATION**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

#### **1.10 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 18 months from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL REQUIREMENTS FOR PANELBOARDS**

- A. Enclosures: Flush or Surface-mounted cabinets as indicated on drawings.
  1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Front: Secured to box with bolts (trim clamps not allowed). For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
    - d. Hinged Front Cover: Entire front trim hinged to box and with piano-hinged door within piano-hinged trim cover.
    - e. Skirt for Surface-Mounted Panelboards: Provide where indicated on Drawings. Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
    - f. Gutter Extension and Barrier: Provide where indicated on Drawings. Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
    - g. Finishes:
      - 1) Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
      - 2) Back Boxes: Galvanized steel.
    - h. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom as indicated on Drawings.
- C. Phase, Neutral, and Ground Buses:
  1. Material: Phase- and Neutral-Bus Material: Copper or Tin-plated, high-strength, electrical-grade aluminum alloy.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box or manufacturer's standard bolted ground bar.
  3. Extra-Capacity Neutral Bus: Provide where indicated on Drawings. Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  1. Material: Tin-plated aluminum circuit-breaker line connections.
  2. Main and Neutral Lugs: Mechanical type.
  3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  4. Provide where indicated on Drawings:
    - a. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
    - b. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
    - c. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated. Series-rating is not allowed.

## **2.01 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D; a brand of Schneider Electric.
  - 2. Eaton.
  - 3. Siemens.
  - 4. ABB.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.
- E. Doors: Door-in-door with full piano-hinged front; secured with flush latch with tumbler lock; keyed alike.

## **2.02 EVENT POWER PEDESTAL ASSEMBLY (“Event Power Pedestal” as shown on Drawings)**

- A. Basis-of-Design: Unmetered service pedestal, TescoFlex by Tesco Controls (916) 395-8800, [www.tescocontrols.com](http://www.tescocontrols.com), or equal by Eaton.
- B. Complete assembly including circuit breakers and receptacles as noted on the Drawings, all in a single pedestal enclosure.
- C. Pedestal shall have a NEMA 3R weatherproof anodized aluminum enclosure, factory painted dark olive green, with a keyed lock. Enclosure door shall provide opening for cords and shall meet 406.8(B)(2)(a) of NFPA 70 to be weatherproof with all attachment plug caps inserted or removed.
- D. Mount on concrete pad with anchor bolts sized per manufacturer's instructions.
- E. Comply with Section 262726 “Wiring Devices” for receptacles furnished in pedestals.

## **2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D; a brand of Schneider Electric.
  - 2. Eaton.
  - 3. Siemens.
  - 4. ABB.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic trip circuit breakers with rms sensing where indicated on Drawings; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and I<sub>2t</sub> response.
    - e. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).



- f. Molded-Case Circuit-Breaker (MCCB) Features and Accessories
  - 1) Standard frame sizes, trip ratings, and number of poles.
  - 2) Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - 3) Application Listing: Appropriate for application. All circuit breakers shall be HACR rated.
  - 4) Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - 5) Shunt Trip: 120 or 24 as required-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
  - 6) Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - 7) Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
  - 8) Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
  - 9) Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - 10) Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## **2.04 ACCESSORY COMPONENTS AND FEATURES**

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION (includes pedestals)**

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install panelboards and accessories according to NECA 407.
- B. Paragraph not used.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with manufacturer's instructions to achieve seismic restraint of panelboard.
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.

- H. Install filler plates in unused spaces.
- I. For flush-mounted panelboards, panelboards in finished spaces, or panelboards serving areas with raised floors: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- K. Comply with NECA 1.
- L. Pedestals: Install in accordance with manufacturer's instructions.

### **3.03 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### **3.04 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: As required, engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Document and certify all testing performed.

### **3.05 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as required.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### **3.06 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION**

## **SECTION 26 27 26 WIRING DEVICES**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. USB receptacles.
  - 3. Twist-locking receptacles.
  - 4. Tamper-resistant receptacles.
  - 5. Weather-resistant receptacles.
  - 6. Snap switches, including motor-rated switches.
  - 7. Cord and plug sets.

#### **1.03 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.

#### **1.05 ACTION SUBMITTALS**

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

#### **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers' Names:
  - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).

2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  3. Leviton Mfg. Company Inc. (Leviton).
  4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## **2.02 GENERAL WIRING-DEVICE REQUIREMENTS**

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  2. Devices shall comply with the requirements in this Section.

## **2.03 STRAIGHT-BLADE RECEPTACLES**

- A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and FS W-C-596.
  1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Screw terminal guards.

## **2.04 GFCI RECEPTACLES**

- A. General Description:
  1. Straight blade, feed-through type.
  2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
  4. Screw terminal guards.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and FS W-C-596.
- C. Weather-Resistant GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement se, and FS W-C-596. Provide for all receptacles located in damp or wet locations.

## **2.05 TAMPER-RESISTANT RECEPTACLES**

- A. Tamper-Resistant, Duplex (125 V, 20 A)
  1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
  2. Line Voltage Receptacles: Two pole, three wire, and self-grounding, NEMA Configuration 5-20R.
  3. Standards: Comply with NEMA WD 1, UL 1310, and FS W-C-596.

## **2.06 USB RECEPTACLES**

- A. Dual USB Type A/C, 5 V dc, and 3.1 A per receptacle (minimum).
  1. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1310, and FS W-C-596.

## **2.07 TWIST-LOCKING RECEPTACLES**

- A. Single Receptacles, NEMA type required for equipment or as noted on Drawings. Comply with NEMA WD 1, NEMA WD 6, and UL 498.
  - 1. Products : Subject to compliance with requirements, provide one of the following:
    - a. Cooper.
    - b. Hubbell.
    - c. Leviton
    - d. Pass & Seymour

## **2.08 CORD AND PLUG SETS**

- A. Description:
  - 1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  - 2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
  - 3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## **2.09 SNAP SWITCHES**

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Heavy-duty, quiet type, AC snap switch with green hex head grounding screw.
  - 1. Provide configurations and ratings noted on drawings. Minimum shall be 120/277 V, 20 A devices.
  - 2. Motor rated switches: rated for 1 hp at 120VAC, 2hp at 240V-277V, with stainless steel cover plate and lockout guard/bracket.
- C. Products: Subject to compliance with requirements, provide products from one of the following:
  - a. Cooper.
  - b. Hubbell.
  - c. Leviton.
  - d. Legrand.

## **2.10 WALL PLATES**

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Satin-finished 302 stainless steel.
  - 3. Material for Unfinished Spaces: 302 stainless steel.
- B. Damp and Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weatherproof while-in-use, die-cast aluminum with lockable cover. Nonmetallic covers are not acceptable.

## **2.11 FINISHES**

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: 302 stainless steel.

- C. Final normal power device color and wall plate finish to be determined by Architect during submittal review.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
  - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  - 8. Tighten unused terminal screws on the device.
  - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
  - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

### **3.02 GFCI RECEPTACLES**

- A. Install non-feed-through-type GFCI receptacles only. Do not protect other downstream receptacles with upstream GFCI receptacle unless noted otherwise on the Drawings.

### **3.03 IDENTIFICATION**

- A. Comply with Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use white self-adhesive machine-printed label on face of plate, and durable wire markers or tags inside outlet boxes.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections
- B. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.

**END OF SECTION**



**SECTION 26 51 00  
LIGHTING**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Interior lighting fixtures.
  - 2. Exterior fixtures, mounted on or in close proximity to the building structure.
  - 3. Emergency lighting units.
  - 4. Exit signs.
  - 5. Lighting fixture supports.
- B. Related Sections:
  - 1. Section 26 05 68 "Exterior Athletic Lighting" for athletic field lighting.
  - 2. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including wall-box dimmers, occupancy sensors, time switches, contactors, and photocells.
  - 3. Section 26 27 26 "Wiring Devices" for manual switches.

**1.03 DEFINITIONS**

- A. BF: Ballast factor.
  - 1. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. LED: Light Emitting Diode

**1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Driver.
  - 4. Energy-efficiency data.
  - 5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for fixtures.
  - 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.

- b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Installation instructions.

#### **1.05 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- B. Product Certificates: For each type of ballast for dimmer-controlled fixtures, from manufacturer.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

#### **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### **1.07 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Fixture-mounted, emergency battery pack: One for every 20 emergency lighting unit.
  - 4. Drivers: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

#### **1.08 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

- E. Mockups: Where required by architect during construction, provide interior lighting fixtures for room or module mockups, complete with power and control connections.
  - 1. Obtain Architect's approval of fixtures for mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.09 COORDINATION**

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## **1.10 WARRANTY**

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
  - 2. Warranty Period for Emergency Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

### **2.02 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS**

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    - b. UV stabilized.
    - c. Glass: Annealed crystal glass unless otherwise indicated.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast/driver characteristics:
  - a. "USE ONLY" and include specific lamp type.
  - b. CCT and CRI for all luminaires.
- G. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

### **2.03 LED DRIVERS**

- A. LED drivers shall meet the following requirements:
  1. Drivers shall have a minimum efficiency of 85%.
  2. Starting Temperature: -40° F.
  3. Input Voltage: 120 to 480 (±10%) V.
  4. Power Supplies: Class I or II output.
  5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 µs, 10kA/8 x 20 µs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C. Units shall be serviceable in-place by owner.
  6. Power Factor (PF): = 0.90.
  7. Total Harmonic Distortion (THD): = 20%.
  8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
  9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

### **2.04 EXIT SIGNS**

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

### **2.05 INTERNALLY LIGHTED SIGNS**

- A. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
- B. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
  1. Battery: Sealed, maintenance-free, nickel-cadmium type.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

### **2.06 EMERGENCY LIGHTING UNITS**

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
  1. Battery: Sealed, maintenance-free, lead-acid type.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

## **2.07 LED SOURCES**

- A. Operating temperature rating shall be between -40° F and 120° F.
- B. Correlated Color Temperature (CCT): as noted on Drawings.
- C. Color Rendering Index (CRI): greater than or equal to 65.
- D. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).

## **2.08 LIGHTING FIXTURE SUPPORT COMPONENTS**

- A. Comply with Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- H. Aircraft Cable Support: Cable, anchorages, and intermediate supports recommended by luminaire manufacturer.

## **2.09 TEMPORARY LIGHTING**

- A. Provide temporary lighting for all trades. Temporary lighting shall consist of festoon Metal-Halide Lamps. Minimum average light level shall be 10 footcandles. The use of permanent luminaires for temporary lighting is not allowed.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Lighting fixtures:
  1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  2. Install lamps in each luminaire.

- B. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least two (2) independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have a minimum breaking strength safety factor of 3 times the weight of the fixture.
- D. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### **3.02 IDENTIFICATION**

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### **3.03 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### **3.04 STARTUP SERVICE**

- A. Burn-in all fixtures that require specific aging period to operate properly, prior to occupancy by Owner.

### **3.05 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
  - 1. Adjust aimable luminaires in the presence of Architect.

## **END OF SECTION**

**SECTION 26 55 68  
ATHLETIC FIELD LIGHTING**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for the project athletic field using an LED lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.
  - 1. Basis of Design: Geo Sport.
  - 2. The local Geo Sport Lighting representative is Mike Torrence with Torrence Sports Lighting, Inc. Phone number is 704-953-0680 and email address is [mtorrence@tsportslight.com](mailto:mtorrence@tsportslight.com).
  - 3. Acceptable alternate manufacturers:
    - a. Musco Lighting.
    - b. WiLLsport Lighting.
- C. The sports lighting will be for the following venues:
  - 1. Soccer.
- D. The primary goals of this sports lighting project are:
  - 2. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore, light levels are guaranteed to not drop below specified target values for a period of 10 years.
  - 3. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators and neighbors.
  - 4. Cost of Ownership: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.

**1.02 LIGHTING PERFORMANCE**

- A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not to drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Soccer	30 FC	2:1	96	30.0' X 30.0'

- B. Color: The lighting system shall have a minimum color temperature of 5700K and a minimum CRI of 70.

- C. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.
- D. In effort to maintain light levels and uniformity in the event of an outage or outages, the minimum number of fixtures shall be supplied per below. Higher wattage fixtures resulting in reduction of fixtures are prohibited as individual outages will immediately materially impact the field of play.

	Soccer		
# of Poles	Pole Designation	Pole Height	Minimum Fixtures
4	S1,S2,S3,S4	70'	11/pole

## 1.2 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control Luminaires: All LED luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external visors.

## PART 2 – PRODUCT

### 2.01 SPORTS LIGHTING SYSTEM CONSTRUCTION

- A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing).
- C. System Description: Lighting system shall consist of the following:
  1. Galvanized direct embedded steel poles and cross-arm assembly.
  2. Non-approved pole technology:
    - a. Wood and concrete poles will not be accepted.
    - b. All luminaires shall be the same wattage and size. Manufacturers utilizing multiple wattage and differing sized fixtures on the same poles and fields will not be accepted.
  3. Lighting systems shall use concrete encased direct burial steel poles.
  4. Manufacturer will supply all drivers and supporting electrical equipment
    - a. Integrated drivers to each luminaire will be utilized. Supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include disconnect, surge protection and fusing. Due to the increased risk of failure and inefficiencies, remote driver systems are not allowed.
    - b. Manufacturer shall provide surge protection at the pole equal to or greater than 75 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2\_2002.



5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
  6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mi/h winds and maintain luminaire aiming alignment.
  7. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
    - a. Integrated grounding via concrete encased electrode grounding system.
    - b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.
- D. Safety: All system components shall be UL listed for the appropriate application.

## **2.02 ELECTRICAL**

- A. Electric Power Requirements for the Sports Lighting Equipment:
1. Electric power: Per Electrical Plans
  2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

## **2.03 STRUCTURAL PARAMETERS**

- A. Sports lighting pole base details shall be designed by a Licensed Professional Structural Engineer from the State of South Carolina and included in the sports lighting package. Stamped engineered designs for pole bases shall be included in shop drawing submittals.
- B. Wind Loads: Wind loads shall be based on ASCE 7-10, Risk Category II 115mph for Prosperity, SC
- C. Poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).
- D. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report. If no geotechnical report is available, the foundation design shall be based on soils that meet or exceed those of a Class 5 material as defined by 2021 SC Building Code Table 1806.2.

## **PART 3 – EXECUTION**

### **3.01 SOIL QUALITY CONTROL**

- A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:
1. Providing engineered foundation embedment design by a registered structural engineer in the State of South Carolina for soils other than specified soil conditions.
  2. Geo Tech Report to be provided by the owner to for the pole structural engineer to design and stamp the foundation drawings.
  3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

### **3.02 DELIVERY TIMING**

- A. Delivery Timing Equipment On-Site: The equipment must be on-site 10 – 12 weeks from receipt of approved submittals and receipt of complete order information.

### **3.03 FIELD QUALITY CONTROL**

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.
- B. Field Light Level Accountability
  - 1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 10 years. These levels will be specifically stated as "guaranteed" on the illumination summary provided by the manufacturer.
  - 2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.
  - 3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities.  
Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.
- C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including foot-candles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

### **3.4 WARRANTY AND GUARANTEE**

- A. 10-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 10 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.
- B. Maintenance: Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

## **PART 4 – DESIGN APPROVAL**

### **4.0 PRE-BID SUBMITTAL REQUIREMENTS (Non-GeoSport)**

- A. Design Approval: The owner / engineer will review pre-bid submittals per section 4.0.B from all the manufacturers to ensure compliance to the specification by the date outlined in the Instructions to Bidders. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued indicating approval for the specific design submitted.
- B. Approved Product: GeoSport Lighting System with CLIR TSL 650w LED is the approved product. All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section by the date outlined in the Instructions to Bidders. Special manufacturing to meet the standards of this specification may be required.

An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.

- C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.
- D. Bidders are required to bid only products that have been approved by this specification or addendum by the owner or owner's representative. Bids received that do not utilize an approved system/design, will be rejected.

**REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED)**

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. Submit checklist below with submittal.

Yes/ No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field & Off Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaires, total kilowatts, average tilt factor; light loss factor.
	D	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	E	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be sealed by a structural engineer licensed in the state of South Carolina. (May be supplied upon award).
	F	Control System	N/A
	G	Warranty	Provide written warranty information including all terms and conditions. Provide five (5) references of customers currently under specified warranty in the state of South Carolina.
	H	Project References	Manufacturer to provide a list of five (5) projects where the technology and specific fixture proposed for this project has been installed in the state of South Carolina. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	I	Product Information	Complete bill of material and current brochures/cut sheets for all product being provided.
	J	Non- Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.

The information supplied herein shall be used for the purpose of complying with the specifications for this Project. By signing below, I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

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

Contact Name: \_\_\_\_\_ Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

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

**END OF SECTION**

**SECTION 31 31 16  
TERMITE CONTROL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Chemical soil treatment.

**1.02 REFERENCE STANDARDS**

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; United States Code; 1947 (Revised 2001).

**1.03 SUBMITTALS**

- A. See Section 01 30 00 – Submittal Procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Maintenance Data: Indicate re-treatment schedule .
- D. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing this type of work and:
  - 1. Having minimum of 2 years documented experience.
  - 2. Approved by manufacturer of treatment materials.

**1.05 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for requirements for application, and comply with EPA regulations.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of toxicants.

**1.06 SEQUENCING**

- A. Retreat the entire building post-demolition and immediately prior to installation of vapor barrier under slabs-on-grade.

**1.07 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
  - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.

**PART 2 PRODUCTS**

**2.01 MIXES**

- A. Mix toxicant to manufacturer's instructions.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

**3.02 APPLICATION**

- A. Comply with requirements of U.S. EPA and applicable state and local codes.

- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
  - 1. Under Slabs-on-Grade.
  - 2. Soil Within 10 feet of Building Perimeter.
- D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- E. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- F. Re-treat disturbed treated soil with same toxicant as original treatment.
- G. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

### **3.03 PROTECTION**

- A. Do not permit soil grading over treated work.

**END OF SECTION**



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