

Project Manual



NEWBERRY COUNTY GALLMAN PLACE RENOVATION

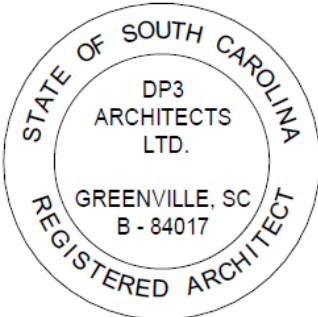
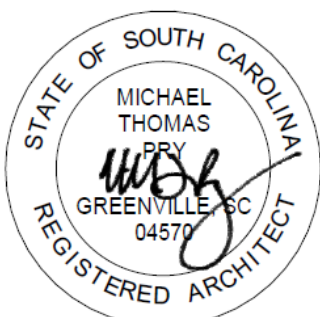
Architect's Project Number:
23234 – B

Newberry County Bid Number:
2026-10

Issue Date:
28 MAY 2026

DP3
ARCHITECTS

**SECTION 00 01 07
SEALS PAGE**

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END OF SECTION

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END OF SECTION

**SECTION 00 11 13
INVITATION TO BID**

Newberry County (Agency) is soliciting sealed bids from qualified contractors for improvements to Gallman Place located at 540 Brantley Street in Newberry, SC 29108.

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: **June 30, 2026** **10:00 AM**

Pre-Bid Meeting Location:

**Gallman Place
540 Brantley Street
Newberry, SC 29108**

WRITTEN QUESTIONS DUE: **July 17, 2026** **5:00 PM**

BID DUE DATE: **July 22, 2026** **3:00 PM**

CONSTRUCTION START DATE: **Fourth Week of August 2026**

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 – GALLMAN PLACE RENOVATION
GENERAL CONTRACTOR'S NAME
GENERAL CONTRACTOR'S ADDRESS
COUNTY BID NUMBER: 2026-10
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 proposed site unless an alternate location is 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 and copied to Josh Kale at jkale@claytonconstruction.net.

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

Project Description:

The Project includes improvements of approximately 12,000 SF of the existing high school to be used for a community center. This includes: upgrades to existing electrical system including new panelboards, upgrades to existing classroom lighting and HVAC (wall units), restroom renovations for accessibility compliance, upgrades to the existing kitchen and cafeteria lighting and HVAC (wall units), upgrades to life safety lighting and fire alarm systems, and new accessible parking spaces at street and an accessible route to the building. Structural repair design of unknown conditions is excluded.

The project is located at 540 Brantley Street, Newberry, SC 29108.

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

Site work:	None
Concrete:	Cast-In-Place Concrete, Concrete Curb & Gutter & Sidewalk
Masonry:	Concrete Unit Masonry
Metals:	None
Wood & Plastics:	None
Thermal & Moisture Protection:	Weather Barriers, Joint Sealants
Doors & Windows:	Hollow Metal Doors and Frames, Flush Wood Doors, Access Doors and Panels, Aluminum-Framed Storefronts
Finishes:	Gypsum Board Assemblies, Tiling, Acoustical Ceilings, Resilient Floor and Base, Tile Carpeting
Specialties:	Panel Signage, Plastic Toilet Compartments, Toilet, Accessories
Equipment:	None
Furnishings:	None
Special Construction:	None
Conveying systems:	None
Plumbing:	Domestic Water Piping, Domestic Water Pumps, Sanitary Waste and Vent Piping, Electric, Domestic-Water Heaters,

Commercial Water Closets, Commercial Urinals, Commercial Lavatories, Commercial Sinks, Drinking Fountains

Mechanical:

Metal Ducts, Air Diffusers, Registers and Grilles, Packed Rooftop Air-Conditioning Units

Electrical:

Raceways and Boxes for Electrical Systems, Lighting Control Devices, Panelboards, Wiring Devices, Fuses, LED Interior Lighting, Emergency and Exit Lighting

Sprinkler System:

Wet-Pipe Sprinkler Systems, Fire Department Connections, Facility Fire-Suppression Piping and Equipment

**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 10% 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

certified copy of Power of Attorney properly executed and dated.

3.16 COMPLIANCE WITH THE SOUTH CAROLINA ILLEGAL IMMIGRATION ACT:

- A. By submitting an offer, Bidder certifies that it will comply with the applicable requirements of Title 8, Chapter 14 of the South Carolina code of Laws (originally enacted as Section 3 of The South Carolina Illegal Immigration act, 2008 S.C. Act No. 280) and agrees to provide upon request any documentation required to establish either: (a) the applicability of Title 8, Chapter 14 to Bidder and any subcontractor or sub-subcontractors; or (b) the compliance with Title 8, Chapter 14 by Bidder and any subcontractors or sub-subcontractors. Pursuant to Section 8-14-60, "A person who knowingly makes or files any false, fictitious, or fraudulent document, statement, or report pursuant to this chapter is guilty of a felony and, upon conviction, must be fined within the discretion of the court or imprisoned for not more than five years, or both". Bidder agrees to include in any contracts with its subcontractors language requiring the subcontractors to (a) comply with the applicable requirements of Title 8, Chapter 14, and (b) include in any contracts with the sub-subcontractors language requiring the sub-subcontract to comply with the applicable requirements of Title 8, Chapter 14.

END OF SECTION

**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 #: 2026-10**
 NEWBERRY COUNTY- GALLMAN PLACE RENOVATION
 540 BRANTLEY STREET
 NEWBERRY, SC 29108

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 – KITCHEN EQUIPMENT AND EXTENDED MEP SCOPE

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

ALTERNATE NO. 2: ADD – RELOCATION OF WATER SERVICE

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

ALTERNATE NO. 3: ADD – ACCESSIBLE PARKING UPGRADES

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

ALTERNATE NO. 4: ADD – CORRIDOR AND CLASSROOM FLOOR FINISH

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

ALTERNATE NO. 5: ADD – KITCHEN FLOOR FINISH

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 **April 26, 2026** 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 **90 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, 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 preceding 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 attached to and made a part of this Bid:

- 1 The undersigned acknowledges that a **Bid security (Bond), in an amount equal to at least 10% 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.
4. Certificate of Insurance showing proof of required coverages.
5. Bidder's Affidavit.
6. Non-collusion Affidavit.
7. NEWBERRY COUNTY requires a copy of the bidder's W-9 to be included in the submission.

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

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 _____, 2026.

(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 and the Construction Manager Josh Kale at jkale@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)	
PROJECT TOTAL		

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 _____, 2026.

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 – GALLMAN PLACE RENOVATION**.

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

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 _____, 2026., 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 _____, 2026.,
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 _____, 2026.

(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 _____, 2026.

(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 – Gallman Place Renovation
- B. Owner's Name: Newberry County
- C. The Project includes improvements of approximately 12,000 SF of the existing high school to be used for a community center. The project is located at 540 Brantley Street, Newberry, SC, 29108.

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. Not applicable.

1.04 OWNER OCCUPANCY

- A. Owner occupy is not intended until a future renovation Project is completed.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

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 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: Kitchen Equipment and Extended MEP Scope from Tie-In Points
 - 1. Base Bid Item: Perform all demolition and new work to prepare space for future kitchen equipment, including tie-ins.
 - 2. Alternative Item: Kitchen equipment and associated Mechanical, Electrical, and Plumbing systems extended from tie-in points. Refer to sheet A3.03 Enlarged Kitchen Plan and Equipment Schedule, Mechanical Drawings, Electrical Drawings, and Plumbing Drawings.
- B. Alternate No. 2: Relocation Of Water Service
 - 1. Base Bid Item: Existing Water Service To Remain.
 - 2. Alternative Item: Water Service Tap As Shown On Drawing C-102.
- C. Alternate No. 3: Accessible Parking Upgrades
 - 1. Base Bid Item: Concrete Ada Ramp And Handrails To Be Constructed.
 - 2. Alternative Item: Accessible Parking Upgrades As Shown On Drawing C-102.
- D. Alternate No. 4: Corridor And Classroom Floor Finish
 - 1. Base Bid Item: All Corridor And Classroom Flooring To Be Sealed Concrete Sc1. Refer To Finish Schedule.
 - 2. Alternative Item: All Corridor And Classroom Flooring To Be Luxury Vinyl Tile Lvt1. Refer To Finish Schedule.
- E. Alternate No. 5: Kitchen Floor Finish
 - 1. Base Bid Item: Existing Floor To Remain In Kitchen 112, Dry Storage 113, And Supply/Storage 115.
 - 2. Alternative Item: Floor Finish In Kitchen 112, Dry Storage 113, And Supply/Storage 115 To Be Vinyl Flooring Vf1. Refer To Finish Schedule.

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.
 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. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- 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: 23234-B – Gallman Place Renovation - Spec Number - Description

END OF SECTION

**SECTION 01 31 50
COORDINATION DRAWINGS**

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 (AS APPLICABLE TO PROJECT SCOPE)

- 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. Overhead Plenum Space
 - d. Mechanical Rooms
 - e. 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. Mechanical Rooms: Showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment, piping and conduit.
 - 5. 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 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 one digital copy 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 surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing 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.
- 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

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. Insulation.
- g. Carpet and pad.
- h. Gypsum board.
- i. Piping.
- j. Wire and cable
- k. Electrical conduit.
- l. 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 care, cleaning, maintenance, and repair 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.

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 18
SITE DEMOLITION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Demolish and remove from the site those items so indicated on the Drawings, including but not limited to buildings, building pads, parking and roadway areas, miscellaneous structures, poles, walls, utilities, signs, etc.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in other divisions of these specifications.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with the International Building Code with due regard to the protection of the public and the provision of safeguards during the performance of the work.
- C. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner.
- D. Comply with requirements of governmental agencies having jurisdiction.
- E. Contractor is responsible for being aware of and complying with Asbestos NESHAP regulations, as well as other applicable codes, laws and regulations.
 - 1. The Owner is to be notified immediately upon discovery of asbestos materials.

PART 2 - PRODUCTS

- A. No products are required in this Section.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to the safe, timely, and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 DEMOLITION

- A. General:
 - 1. Prior to start of demolition, carefully study the Drawings and these Specifications.
 - 2. In company with the Owner's representative, visit the site and verify the extent of demolition to be performed under this Contract.
- B. Using only the means and equipment approved for this purpose by the governmental agencies having jurisdiction, demolish and completely remove from the job site the existing construction designated to be removed.
 - 1. Shut off, cap, reroute, and otherwise protect existing public utility lines in accordance with the requirements of the public agency or utility having jurisdiction.
 - 2. Remove rocks larger than 3" diameter, roots, wood, and debris.
- C. Demolished site material shall be considered to be property of the Contractor and shall be completely removed from the job site.
- D. Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- E. Use any means necessary to protect the public safety during the demolition process.
- F. Use whatever means necessary to protect the adjacent structures from damage during demolition.
- G. Protection of trees: It may become desirable to save certain trees in areas where cut or fill is eighteen inches or less and in parking areas. Consequently, the Contractor shall obtain approval from Engineer prior to removal of significant trees from such areas. The Contractor shall protect existing trees to remain during construction by constructing barricades around such trees as directed.
- H. Erosion control: Construct and maintain erosion control as shown on the Drawings and in accordance with the local County's requirements.

3.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

SECTION 02 41 16 STRUCTURE DEMOLITION

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. Demolition and removal of building improvements.
 - 2. Abandoning in-place.
 - 3. Disconnecting, capping or sealing, and abandoning in-place or removing appurtenances.
 - 4. Salvaging items for reuse by Owner.
- B. Related Requirements:
 - 1. Section 31 10 01 "Site Clearing and Grubbing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse store. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

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

1.5 PREDEMOLITION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for noise control and dust control.
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Owner.

1.6 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.
 - 1. Adjacent Buildings: Detail special measures proposed to protect garage to remain.
- C. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 - 2. Temporary interruption of utility services.
 - 3. Shutoff and capping of utility services.
- D. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before the Work begins.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 - 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
 - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before building demolition, Owner will remove the following items:
 - a. Verify with Owner items to be removed.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site storage or sale of removed items or materials is not permitted.

1.9 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Verify with a professional engineer of the condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

- A. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
- C. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
4. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of demolition.
- C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."
 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 2. Maintain fire watch during and for at least hours after flame-cutting operations.

3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvage: Items to be removed and salvaged for the Owner and/or reuse are indicated on Drawings and below. Contractor is allowed to Salvage and retain items as needed or wanted:
 1. Doors and door hardware.
 2. Windows.
 3. Cabinets.
 4. Mirrors.
 5. Chalkboards.
 6. Tackboards.
 7. Marker boards.
 8. Plumbing fixtures.
 9. Other items not noted.
- D. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet (1.5 m) outside footprint indicated for new construction. Abandon below-grade construction outside this area.
 1. Remove below-grade construction, including basements, foundation walls, and footings, completely.
 2. Maintain Utilities for existing Garage to remain.
- E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet (1.5 m) outside footprint indicated for new construction. Abandon utilities outside this area.
 1. Fill abandoned utility structures with satisfactory soil materials recycled pulverized concrete
- F. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder, plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.

3.7 SITE RESTORATION

- A. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between

adjacent existing grades and new grades.

3.8 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.10 CLEANING

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

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide cast-in-place concrete, including formwork and reinforcement, where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Reference standards: Comply with the following codes, specifications and standards, except as otherwise shown or specified:
 - 1. American Concrete Institute (ACI) Publications:
 - ACI 301 Specification for Structural Concrete for Buildings
 - ACI 305 Recommended Practice for Hot Weather Concreting
 - ACI 306 Recommended Practice for Cold Weather Concreting
 - ACI 315 Manual of Standard Practice for Detailing Reinf Concrete Structures
 - ACI 318 Building Code Requirements for Reinforced Concrete
 - ACI 347 Recommended Practice for Concrete Framework
 - 2. American Society for Testing and Materials (ASTM) Publications:
 - A185 Welded Steel Wire Fabric for Concrete Reinforcement
 - A615 Deformed and Plain Billet Steel Bars for Concrete Reinf
 - C31 Making and Curing Concrete Test Specimens in the Field
 - C33 Concrete Aggregates
 - C39-72 Compressive Strength of Cylindrical Concrete Specimens
 - C94 Ready-Mixed Concrete
 - C150 Portland Cement
 - C260 Air-Entraining Admixtures for Concrete
 - 3. Concrete Reinforcing Steel Institute (CRSI): "Manual of Standard Practice"
 - 4. American Welding Society (AWS) Publication:
 - D12.1-61 Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete
- C. Testing agency: A testing laboratory will be retained by the Owner to perform material evaluation tests required by these specifications.
- D. Qualifications of contractors performing concrete work: Minimum of two (2) years experience on comparable concrete projects.

- E. Plant qualification: Plant equipment and facilities shall meet all requirements of the Check List for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association and ASTM C94.

1.3 SUBMITTALS

- A. Comply with the pertinent provisions of the Contract Documents.
- B. Within 15 calendar days after receiving the Owner's Notice to Proceed, submit proposed mix designs for approval.
 - 1. Proportions shall be determined by means of laboratory tests of concrete made with the cement and aggregate proposed for use.
 - 2. Provide report in detail from an approved testing laboratory showing 7-day and 28-day strengths obtained using materials proposed.
 - 3. Required average strength above specified strength:
 - a. Determinations of required average strength above specified strength (f_c) shall be in accordance with ACI 318 and ACI 301.
 - b. Establish the required average strength of the design mix using the materials proposed to be employed. Standard deviations shall be determined by thirty tests. Average strength used for selecting proportions shall exceed specified strength (f_c) by at least:

400 psi	Standard deviation is less than 300
550 psi	Standard deviation is 300 to 400
700 psi	Standard deviation is 400 to 500
900 psi	Standard deviation is 500 to 600
1200 psi	Standard deviation is above 600 or unknown
 - c. When the ready-mix producer does not have a record of past performance, the combination of materials and the proportions selected shall be selected from trial mixes having proportions and consistencies suitable for the work using at least three (3) different water/cement ratios which will produce a range of strengths encompassing those required. Average strength required shall be 1200 psi above specified strength.
 - 4. Cost of this work shall be borne by the Contractor.
- C. Manufacturer's data: Submit manufacturer's specification with application instructions for proprietary materials and items, including curing compound, form release agents, admixtures, patching compounds, and others as required by the Engineer.
- D. Shop drawings: Submit the following shop drawings to the Engineer for approval before work is started:
 - 1. Reinforcing steel drawings: Prepare in accordance with ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, dimensions and details of bar reinforcing and accessories.
 - 2. Cementitious coating.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 60 01.
- B. Store reinforcement in a manner that will avoid excessive rusting or coating by grease, oil, dirt and other objectionable materials.
- C. Keep reinforcement in separate piles or racks so as to avoid loss of identification after bundles are broken.

PART 2 - PRODUCTS

2.1 FORMS

- A. Use form materials conforming to ACI 347.
- B. Form lumber: Use lumber of sufficient quality and grade, size and stiffness to adequately support the work and ensure dimensional accuracy.
- C. Form ties: Use form ties which do not leave an open hole through the concrete and which permit neat and solid patching at every hole.
 - 1. Use ties with cones that allow a 1" break back and facilitate patching.
 - 2. On structures containing water or other liquid or below grade structures, use embedded rod ties with integral waterstops in addition to cones.
 - 3. Through-bolts that utilize a removable tapered sleeve in water containing and below grade applications: Use mechanical EPDM rubber plugs to seal holes made after removal of taper ties. Acceptable product is X-Plug by the Greenstreak Group, Inc. 800-325-9504. Follow manufacturers' instructions for installation. Friction fit plugs are not allowed.
 - 4. Wire ties and wood spreaders will not be permitted.
- D. Form coatings: Form release coating shall be neat oil with surface wetting agent or chemical release agent which effectively prevents absorption of moisture, prevents bonding with concrete, is non-staining to concrete and leaves the concrete with a paintable surface.
 - 1. On surfaces to receive an applied coating, use a residual free chemical form release agent which is compatible with the applied coating and will not prevent the applied finish from satisfactorily bonding to the concrete.
- E. Chamfer strips: Chamfer strips shall be wood or polyvinyl strips or approved equal, designed to be nailed in the forms to provide a 3/4" chamfer (unless indicated otherwise) at all exposed edges and corners of concrete members.

2.2 REINFORCEMENT

- A. Comply with the following as minimums:
 - 1. Bars: ASTM A615, Grade 60, unless otherwise shown on the Drawings, using deformed bars for Number 3 and larger.
 - 2. Welded wire fabric: ASTM A185.
 - a. Use sheet (mat) welded wire fabric only.

- b. Welded wire fabric supplied in rolls will not be accepted.
 3. Bending: ACI 315 and ACI 318.
- B. Fabricate reinforcement to the required shapes and dimensions, within fabrication tolerances stated in the CRSI "Manual of Standard Practices".
- C. Do not use reinforcement having any of the following defects:
 1. Bar lengths, depths, or bends exceeding the specified fabricating tolerances.
 2. Bends or kinks not indicated on the Drawings or required for this Work.
 3. Bars with excessive rust, scale, dirt, oil or other defects which will reduce the bond or the effective cross section of the bar.
- D. Furnish all support bars, tie bars, chairs, bolsters, etc. required for properly supporting and spacing bars in the forms.
 1. For slabs on grade, use supports with stand plates or horizontal runners where wetted base materials will not support chair legs. Other supports must be approved by the Engineer.
 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are hot-dip galvanized, plastic protected or stainless steel.
 3. Supply supports for welded wire fabric as follows:

Welded Wire Fabric Support Spacing

Welded Wire Reinforcement (diameter)	Welded Wire Spacing (inches)	Maximum Support Spacing (feet)
W9 or larger	12 and greater	4
W5 to W8	12 and greater	3
W9 and larger	Less than 12	3
W4 to W8	Less than 12	2
Less than W4	Less than 12	1.5

- E. Tie wire: FS QQ-W-461, annealed steel, black, 16 gauge minimum.
- F. Welding electrodes: AWS A5.1, low hydrogen, E70 series.
- G. Splice devices: Shall be sized to develop one hundred twenty-five (125%) percent of yield strength of bar.

2.3 CONCRETE MATERIALS

- A. Cement: Use portland cement: ASTM C150, Type I, Type I-P or Type II, low alkali.
 1. Where concrete will be exposed to sewage, use Type II or I-P cement.
 2. Fly ash shall conform to ASTM C618, Class C or F.
 3. Fly ash content shall not exceed 20% by weight of the total amount of cementitious materials (portland cement plus fly ash).
- B. Aggregates:
 1. Fine aggregate: Conform to ASTM C33.

2. Coarse aggregate: Conform to ASTM C33, Size #57.
- C. Water: Clean and potable and free from injurious amounts of deleterious materials.
- D. Admixtures:
1. Air entraining admixture: ASTM C260.
 2. Water reducing, set controlling admixture: Conform to ASTM C494.
 - a. Type A - water reducing.
 - b. Type D - water reducing and retarding.
 3. Superplasticizers: Conform to ASTM C494, Types F and G.
 - a. Use superplasticizers in thin section placements and in areas of congested reinforcing and/or embedded items, or where otherwise approved by the Engineer.
 - b. Use where conventional consolidation techniques are impractical.
 4. Do not use admixtures containing calcium chloride.
- E. Fiber reinforcing:
1. Use fiber reinforcing where indicated on the drawings.
 2. Provide polypropylene or co-polymer fibers as manufactured by High Tech Fibers, Inc., Fibermesh Company or an approved equal.
 3. Where required, use fiber reinforcing at a rate of 2.0 lbs. per cubic yard unless another rate is indicated on the drawings.
- F. Curing compounds:
1. On all vertical and formed surfaces, construction joints, basin slabs, surfaces to receive an applied coating or finish, and other surfaces except as otherwise indicated or specified, use a non-residual, non-staining curing compound conforming to ASTM C309 Type 1 and 1D. Acceptable products are:
 - a. L&M Cure by L&M Construction Chemicals, Inc.
 - b. Horn WB-75 by A.C. Horn Company.
 - c. Sonosil by Sonneborn, Inc.
 - d. Approved equal.
 2. On building floor slabs not otherwise receiving an applied coating or finish and on other flatwork as indicated on the Drawings, provide an acrylic copolymer curing and sealing compound conforming to ASTM C309 Type 1 and the following:
 - a. Non-yellowing.
 - b. Minimum 20% solids.
 - c. Maximum unit moisture loss in accordance with ASTM C156 - 0.40 kg./sq.m at 72 hours.
 - d. Acceptable products are Dress & Seal by L&M Construction Chemicals, Inc., Clear Seal Standard by A. C. Horn Company, Kure-N-Seal 0800 by Sonneborn, Inc., or approved equal.

2.4 CONCRETE MIXES

- A. Provide concrete with the compressive strengths shown on the Drawings. When such strengths are not shown on the Drawings, provide the following 28-day strengths as minimum:
1. All structural concrete except as indicated in No. 2 and No. 3 below or as noted otherwise on the plans: 4000 psi.

2. All sidewalks, curbs and gutters, and unreinforced foundations with fiber reinforcing: 4000 psi.
 3. Thrust blocking, backfill or encasement for piping, and concrete fill: 2500 psi.
 4. Prestressed or precast concrete: 5000 psi.
- B. Maximum water cement ratios:
- | | |
|-------------------|------|
| 4000 psi concrete | 0.5 |
| 3000 psi concrete | 0.53 |
| 2500 psi concrete | 0.67 |
- C. Entrained air:
- | | |
|----------------------------|--------------|
| 3000 and 4000 psi concrete | 5% ± 1% |
| 2500 psi concrete | Not Required |
- D. Slump:
- | | |
|----------------------------|---------|
| 3000 and 4000 psi concrete | 4" ± 1" |
| 2500 psi concrete | 5" ± 1" |
- E. Production of concrete:
1. General: Concrete shall be ready mixed and shall be batched, mixed and transported in accordance with ASTM C94 except as otherwise indicated.
 2. Monitor time and mix proportions by plant delivery slips.
 3. Air entraining admixtures: Add air entraining admixture into the mixture as a solution and measure by means of an approved mechanical dispensing device.
 4. Water reducing and retarding admixture: Add water reducing and retarding admixture and measure as recommended by the manufacturer.
 5. Addition of water to the mix upon arrival at the job site shall not exceed that necessary to compensate for a 1" loss in slump, nor shall the design maximum water-cement ratio be exceeded. Water shall not be added to the batch at any later time.
 6. Weather conditions: Control temperature of mix as required by ACI 306 "Cold Weather Concreting" and by ACI 305 "Hot Weather Concreting".

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Water, mud, organic, and other detrimental material shall be removed from excavations before concrete is deposited.
- C. Notify the Engineer prior to placing concrete and place no concrete until the formwork, reinforcing and embedded items have been observed by the Engineer.

3.2 FORMWORK

A. General:

1. Construct forms in conformance with ACI 347.
2. Design, erect, support, brace and maintain formwork so it will safely support vertical and lateral loads which might be applied until such loads can be supported safely by the concrete structure.
3. Construct forms to the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in the finished structure.
4. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and prevent fins.

B. Form construction and erection:

1. Construct forms in conformance with ACI 347.
2. Provide for openings, offsets, keyways, recesses, moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts and other embedded items as required.
3. Hold inner and outer forms for vertical concrete together with combination steel ties and spreaders approved by the Engineer.
4. Unless specifically stated otherwise, provide 3/4" chamfer at all exposed edges of concrete.
5. Provide temporary openings in the formwork where necessary to facilitate cleaning and inspection of the formwork.
6. Coat form contact surfaces with approved form coating compound prior to placing reinforcing steel.
7. Do not allow excess form coating material to accumulate in the forms or to come in contact with reinforcing surfaces which will bond to fresh concrete.
8. Side forms for footings may be omitted, and concrete may be placed directly against excavation only when requested by the Contractor and approved by the Engineer.
9. Provide a positive means of adjustment of shores and struts and ensure that all settlement is taken up during concrete placing.
10. Construct blockouts and formed openings of sufficient size and proper location to permit final alignment of items within it or passing through it.
 - a. Allow sufficient space for grouting, packing or sealing around any items penetrating the opening as may be required to ensure watertightness.
 - b. Provide openings with continuous keyways with waterstops where required, and provide a slight flare to facilitate grouting and the escape of entrapped air during grouting.
 - c. Provide only blockouts or openings that are shown on the drawings or otherwise approved by the Engineer.

C. Formwork reuse: Reuse only forms that are in good condition and which maintain a uniform surface texture on expose concrete surfaces.

1. Apply a light sanding as necessary to obtain a uniform texture.
2. Plug unused tie holes and penetrations flush with the form surface.

- D. Removal of forms:
1. Do not disturb or remove forms until the concrete has hardened sufficiently to permit form removal with complete safety. Do not remove shoring until the member has acquired sufficient strength to support its own weight, the load upon it, and the added load of construction.
 2. Do not remove forms before the following minimum times without prior approval from the Engineer:
 - a. Sides of footings or slabs on grade 24 hrs
 - b. Walls not supporting load 48 hrs
 - c. Vertical sides of beams 48 hrs
 - d. Columns not supporting load 48 hrs
 - e. Suspended slabs or beam bottoms (forms only) 10 days
 3. In determining the minimum stripping times, consider only the cumulative time during which the ambient temperature of the air surrounding the concrete is above 50°.
 4. Do not remove shoring for suspended slabs or beams until the concrete has reached 75% of the specified 28 day strength.
 5. When reshoring or backshoring is permitted or required, plan the operations in advance and submit procedures to the Engineer for approval.
 - a. Design and plan all reshoring operations to support all construction loading and in accordance with ACI 347.
 6. Exercise care in removing forms from finished concrete surfaces so that surfaces are not marred or gouged and that corners are true, sharp and unbroken.
 7. Do not permit steel spreaders, form ties, or other metal to project from or be visible on any concrete surface except where so shown on the drawings.
 8. Whenever the formwork is removed during the curing period, continue to cure the exposed concrete by one of the methods specified herein.

3.3 EMBEDDED ITEMS

- A. Embedded items: Set anchor bolts and other embedded items accurately and securely in position in the forms until the concrete is placed and set.
1. Use templates where practical for all anchor bolts.
 2. Check locations of all anchor bolt and special castings prior to placing concrete and verify locations after concreting.
- B. Piping cast in concrete:
1. Install and secure sleeves, wall pipes and pipe penetrations before placing concrete.
 2. Do not weld or otherwise attach piping to reinforcing steel.
 3. Support piping to be encased in concrete securely and on firm foundation so as to prevent movement or settlement during concreting.
- C. Locate electrical conduit so that it will not impair the strength of the construction.
1. Do not use conduits running within (not passing through) a slab, wall or beam that are larger in outside diameter than 1/3 overall concrete thickness unless otherwise approved by the Engineer.
 2. Do not space conduits closer than three conduit diameters apart unless otherwise approved by the Engineer.

3.4 REINFORCEMENT

- A. General: Comply with the specified codes and standards and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports and as herein specified.
 - 1. Clean reinforcement and remove loose dust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
 - 2. Position and secure reinforcement against displacement by forms, construction, and the concrete placement operations.
 - 3. Use adequate number of ties to secure reinforcing.
 - 4. Do not weld or field bend reinforcing without prior approval by the Engineer.
- B. Placing reinforcing:
 - 1. Provide and install all chairs, runners, bolsters, standees and other accessories in sufficient quantities to satisfactorily position the reinforcing and hold it in place during concrete placement.
 - 2. Support reinforcing for slabs on ground on chairs or bolsters with stand plates or a properly sized concrete cube.
 - a. Use concrete bricks as supports only as approved by the Engineer.
 - 3. Secure and tie dowels in place prior to placing concrete. Do not press dowels into wet concrete.
- C. Concrete cover: Unless otherwise indicated on the drawings or specified herein, install reinforcing with clear concrete coverage in conformance with ACI 318.
 - 1. All reinforcement, regardless of size, exposed to water or sewage shall have 2" cover.
 - 2. Place reinforcement a minimum of 2" clear of any openings or metal pipe or fittings.
- D. Splicing reinforcement: Splice reinforcement steel in accordance with the latest revisions of ACI 318 "Building Code Requirements for Reinforced Concrete" unless shown otherwise on the drawings.
 - 1. All splices at wall corners or intersections and at wall and foundation intersections shall be Class B tension splices per ACI 318, Sections 12.2.2 and 12.15.
 - 2. All other splices of vertical or horizontal steel in walls shall be Class B tension splices as per ACI 318 per ACI 318, Sections 12.2.2 and 12.15.
 - 3. Horizontal ring steel in circular, non-prestressed concrete tanks shall be Class B tension splices and the splices shall be staggered so that no more than 50% of the bars are spliced at any one location.
 - 4. All welded or mechanical splicing devices shall develop 125% of the yield strength of the bar.
 - 5. Column vertical bars shall lap 30 bar diameters with dowels at the base of the column unless otherwise noted. Dowels shall be the same size and quantity as column vertical bars unless otherwise noted.
 - 6. All splices not otherwise shown or specified shall be Class B tension lap splices per ACI 318, Sections 12.2.2 and 12.15.
- E. Tolerances: Place bars in the locations indicated within the tolerances conforming to the CRSI "Manual of Standard Practice".

- F. Welded wire mesh: Install welded wire fabric in as long of a length as practicable and lay flat before placing concrete.
1. Use only mat welded wire fabric. Do not use welded wire fabric from rolls.
 2. Support and tie mesh to prevent movement during concrete placement.
 3. Lap adjoining pieces at least one full mesh and lace splices with wire.
 4. Provide, at a minimum, supports for welded wire fabric according to the Table in Section 2.2.D.3. Confirm the adequacy of the support spacings listed therein for the anticipated construction loads. Increase the number of supports, if necessary, to assure that the final position of the welded wire fabric will conform to that shown on the drawings.
 5. Do not place welded wire fabric on the subbase surface and then hook or "pull up" the reinforcement during concrete placement.
 6. Do not lay welded wire fabric on top of the freshly placed concrete and then "walk it" into place.

3.5 PLACING CONCRETE

- A. Preparation:
1. Remove foreign matter accumulated in the forms.
 2. Rigidly close openings left in the formwork.
 3. Wet wood forms sufficiently to tighten up cracks. Wet other material sufficiently to maintain workability of the concrete.
 4. Use only clean tools.
 5. Provide and maintain sufficient tools and equipment on hand to facilitate uninterrupted placement of the concrete.
 6. Before commencing concrete, inspect and complete installation of formwork, reinforcing steel and all items to be embedded or cast-in.
- B. Conveying:
1. Transport and handle concrete from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete.
 2. Provide equipment for lifting, dumping, chuting, pumping or conveying the concrete, of such size and design as to ensure a practically continuous flow of concrete at the delivery and without separation of materials.
 3. Use hoppers and elephant trunks where necessary to prevent the free fall of concrete for more than 4'.
 4. Do not use concrete that is not placed within 1-1/2 hours after water is first introduced into the mix unless the slump is such that it meets the specified limits without the addition of water to the batch.
- C. Placing:
1. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to rehandling and flowing.
 2. Deposit concrete in horizontal layers not deeper than 2', avoiding inclined layers.
 3. Place concrete at such a manner that concrete upon which fresh concrete is deposited is still plastic.
 4. Bring slab surfaces to the correct level with screeds set to the proper elevation.
- D. Hot weather placement: Place concrete in hot weather in accordance with ACI 305 "Hot Weather Concreting" and as specified herein.

1. Do not place concrete whose temperature exceeds 100°F.
 2. Thoroughly wet forms and reinforcing prior to placement of concrete.
 3. Use additional set retarder as necessary to increase set time.
 4. Limit the size of the pour where it may reduce the likelihood of cold joints due to reduced set time.
 5. Shade the fresh concrete as soon as possible after placing.
 6. Start curing as soon as the concrete is sufficiently hard to permit without damage.
- E. Cold weather placement: Place concrete in cold weather in accordance with ACI 306 and as specified herein.
1. Except when authorized specifically by the Engineer, do not place concrete when the atmospheric temperature is below 40°F.
 2. When cold weather placement is approved by the Engineer, heat either the mixing water or aggregate or both so that the concrete temperature is between 65°F and 85°F.
 3. Protect the freshly placed concrete by adequate housing or covering and provide heat to maintain a temperature of not less than 50°F for not less than four days.
 4. Do not add salts, chemicals, or other materials to the concrete mix to lower the freezing point of the concrete.
- F. Consolidation:
1. Consolidate each layer of concrete immediately after placing, by use of internal concrete vibrators supplemented by hand spading, rodding, or tamping.
 - a. Use vibrators having a 2" head diameter and a minimum frequency of 8000 vibrations per second.
 - b. Provide sufficient number of vibrators to properly consolidate the concrete, keeping up with placement operations.
 - c. Provide at least one spare vibrator on site.
 2. Insert and withdraw vibrators at points approximately 18" apart.
 3. Do not vibrate forms or reinforcement.
 4. Do not use vibrators to transport concrete inside the forms.

3.6 PROTECTION

- A. Protect the surface finish of newly placed concrete from damage by rainwater or construction traffic.
- B. Do not apply design loads to structures until the concrete has obtained the specified strength.
1. Do not backfill against walls until they have reached the specified strength and all supporting or bracing walls, slabs, etc. have also reached the specified strength, unless otherwise permitted by the Engineer.
 2. Protect structures from construction overloads.

3.7 CURING

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures and mechanical injury.

- B. Continuously cure concrete for a period of not less than 7 days after placement.
1. When seven-day cylinder breaks indicate, in the opinion of the Engineer, the possibility of low strength concrete, provide additional curing as per the request of the Engineer.
 2. When temperatures during the curing period fall below 40°F, provide additional curing time as directed by the Engineer.
- C. Unless otherwise directed by the Engineer, cure concrete not in contact with forms in accordance with one of the following procedures:
1. Ponding or sprinkling: Keep entire concrete surface wet by continuously sprinkling or by allowing water to pond, covering all surfaces.
 2. Wet burlap: Thoroughly wet and cover all concrete surfaces with wet burlap mats as soon as the concrete has set sufficiently to avoid marring the surface.
 - a. Keep the burlap continuously wet during the curing period.
 3. Curing blankets: Thoroughly wet concrete surfaces to be cured and cover with curing blankets as soon as the concrete has set sufficiently to avoid marring the surface.
 - a. Weight the blankets down to maintain close contact with the concrete surface.
 - b. Use sheets of waterproof kraft paper with the joints between sheets taped continuously; or
 - c. Use sheets of 4 mil or thicker polyethylene with the joints between sheets continuously taped.
 4. Wet sand: Apply a layer of sand over the entire surface and keep it continuously wet.
 5. Curing compound: Apply curing compound immediately after completion of the finish on unformed surfaces and within two hours after removal of forms on formed surfaces.
 - a. Spray the entire surface with two coats of liquid curing compound, applying the second coat in the direction of 90° to the first coat.
 - b. Apply compound in accordance with the manufacturer's instructions to cover the surface with a uniform film which will seal thoroughly.
- D. Hot weather: When necessary, provide wind breaks, shading, fog spraying, sprinkling, ponding or wet covering with a light colored material applying as quickly as concrete hardening and finishing operations will allow.

3.8 CONCRETE FINISHING

- A. Finish schedule: Unless otherwise indicated on the drawings, finish all concrete surfaces in accordance with the following schedule:
1. Form finish: Formed surfaces not ordinarily exposed to view, including:
 - a. Interior walls of open tanks below a line one foot lower than the lowest normal water level.
 - b. The underside of slabs not exposed to view.
 - c. Walls below grade.
 2. Cementitious coating: All formed surfaces exposed to view including:
 - a. Interior walls of tanks above a line one foot lower than the lowest normal water level.
 - b. The underside of slabs, soffits, etc. exposed to view.

3. Float finish: Slab surfaces not exposed to view or not receiving an applied thin finish, including:
 - a. Bottom slabs of tanks or structures containing water sewage or other liquid.
 - b. Foundations not exposed to view.
 - c. Roof slabs to be covered with insulation and/or built-up roofing.
4. Trowel finish: Interior slab surfaces exposed to view or to receive an applied thin film coating or floor finish, including:
 - a. Interior, indoor slabs and floors of buildings.
 - b. Surfaces on which mechanical equipment moves.
 - c. Floors receiving vinyl tile, resilient flooring, carpet, paint, etc.
5. Broom finish: Exterior, outdoor slabs exposed to view including:
 - a. Outdoor floor slabs and walkways.
 - b. Other floors which may become wet or otherwise require a non-skid surface.
 - c. Sidewalks and concrete pavements.
6. Scratch finish: Surfaces which are to receive a thick topping or additional concrete cast against them including:
 - a. Surfaces receiving concrete equipment pads.
 - b. Floors receiving concrete topping.
 - c. Construction joints not otherwise keyed.
7. Edge finish: Exposed edges of slabs not receiving chamfer including:
 - a. Sidewalk edges and joints.
 - b. Pavement edges and joints.
 - c. Other slab edges not chamfered.

B. Finishing procedures:

1. Form finish:
 - a. Repair defective concrete.
 - b. Fill depressions deeper than 1/4".
 - c. Fill tie holes.
 - d. Remove fins exceeding 1/8" in height.
2. Cementitious finish:
 - a. Patch all tie holes and defects and remove all fins.
 - b. Within one day of form removal, fill all bug holes, wet the surfaces and rub with carborundum brick until a uniform color and texture are produced; or
 - c. Dampen surfaces, brush apply a grout slurry consisting of 1 part portland cement to 1-1/2 parts sand, and rub the surface vigorously with a stone. Remove all excess grout.
 - d. Provide a two coat cement base waterproofing, sealing finish of Thoroseal and Thoroseal Plaster Mix as manufactured by Standard Dry Wall Products, Inc. or an approved equal.
 - 1) Patch all tie holes and defects and removal all fins, and clean surface of all dirt, laitance, grease, form treatments, curing compounds, etc.
 - 2) Key coat: Apply key coat of Thoroseal at a rate of two (2) lbs. per sq. yd. by fiber brush. Mix material using one part of Acryl 60 to three parts clean water. Should material start to drag during application, dampen surface with water. During hot weather periods, dampen surfaces with water prior to application of key coat material. Key coat shall be allowed to cure for five (5) days before applying finish coat.

- 3) Apply a finish coat consisting of a four (4) to six (6) lbs. per sq. yd. application of Thoroseal Plaster Mix using steel trowel or spray gun. Color to be selected by the Owner. Mix dry material using one (1) part Acryl 60 to three (3) parts clean water. Firmly press the mix into all voids and level with a steel trowel. When surface is set so that it will not roll or lift, float it uniformly using a sponge float.
3. Float finish:
 - a. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.
 - b. Cut down all high spots and fill all low spots and float the slab to a uniform sandy texture.
4. Trowel finish:
 - a. Float finish as specified herein.
 - b. Power trowel to a smooth surface free of defects.
 - c. After the surface has hardened sufficiently, hand trowel until a ringing sound is produced as the trowel is moved over the concrete surface.
5. Broom finish:
 - a. Float finish as specified herein.
 - b. Provide a scored texture by drawing a broom across the surface.
6. Scratch surface:
 - a. Screed the surface to the proper elevations.
 - b. Roughen with rakes or stiff brushes.
7. Edge finish: Tool slab edges and joints with a 1/4" radius edging tool.

3.9 SURFACE REPAIR

- A. Patching mortar:
 1. Make a patching mortar consisting of 1 part portland cement to 2-1/2 parts sand by damp loose volume.
 2. Mix the mortar using one part acrylic bonding admixture to two parts water.
- B. Tie holes: Clean and dampen all tie holes and fill solidly with patching mortar.
- C. Surface defects:
 1. Remove all defective concrete down to sound solid concrete.
 2. Chip edges perpendicular to the concrete surface or slightly undercut, allowing no feather edges.
 3. Dampen surfaces to be patched.
 4. Patch defects by filling solidly with repair mortar.
- D. Allow the Engineer to observe the work before placing the patching mortar.
- E. Repair defective areas greater than 1 sq. ft. or deeper than 1-1/2" as directed by the Engineer using materials approved by the Engineer at no additional expense to the Owner.

3.10 JOINTS

- A. Construction joints:
 - 1. Unless otherwise approved by the Engineer, provide construction joints as shown on the drawings.
 - 2. If additional construction joints are found to be required, secure the Engineer's approval of joint design and location prior to start of concrete placement.
 - 3. Continue all reinforcing across construction joints and provide 1-1/2" deep keyways unless indicated otherwise on the drawings.
 - a. Form keyways in place.
 - 4. Provide waterstops in all construction joints of liquid containing structures, structures below grade or other structures as shown on the drawings.
- B. Expansion joints:
 - 1. Provide expansion joints of size, type and locations as shown on the drawings.
 - 2. Do not permit reinforcement or other embedded metal items that are being bonded with concrete (except smooth dowels bonded on only one side of the joints, where indicated on the drawings) to extend continuously through any expansion joint.
 - 3. Provide waterstops where required.
- C. Control or contraction joints:
 - 1. Locate and construct control and contraction joints in accordance with the Drawings.
 - 2. Where no specific joint pattern is indicated in slabs on grade or concrete pavements, submit a proposed joint layout to the Engineer for approval.
 - 3. Where no specific joint details are shown on the drawings, joints may be tooled, preformed or saw-cut.
 - 4. Saw-cut joints as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw.

3.11 FIELD QUALITY CONTROL

- A. Concrete cylinder tests:
 - 1. During construction, prepare test cylinders for compressive strength testing, using 6" diameter by 12" long single use molds, complying with ASTM C31.
 - a. Make a set of three test cylinders from each pour of 50 cubic yards or less, plus one additional set of cylinders for each additional 50 cubic yards or fraction thereof.
 - b. Identify each and tag cylinder as to date of pour and location of concrete which it represents.
 - c. Deliver cylinders to testing lab selected by the Owner.
 - d. Cost for preparation and delivery of cylinders shall be borne by the Contractor. Cost for testing cylinders will be borne by the Owner.
 - 2. Should strengths shown by test cylinders fail to meet specified strengths for the concrete represented, then:
 - a. Engineer shall have the right to require changes in the mix proportions as he deems necessary on the remainder of the work.
 - b. Additional curing of those portions of the structure represented by the failed test cylinders shall be accomplished as directed by the Engineer.

- c. Upon failure of the additional curing to bring the concrete up to specified strength requirements, strengthening or replacement of those portions of the structure shall be as directed by the Engineer.
 - d. The Engineer may require additional testing of concrete in question by either non-destructive methods such as the Swiss Hammer, Windsor Probe or Ultrasonics or by coring and testing the concrete in question in accordance with ASTM C42. Such testing shall be performed at no additional cost to the Owner.
- B. Other field concrete tests:
 - 1. Slump tests: Either the Engineer or a testing laboratory representative will make slump tests of concrete as it is discharged from the mixer.
 - a. Slump test may be made on any concrete batch at the discretion of the Engineer.
 - b. Failure to meet specified slump requirements (prior to addition of any superplasticizers) will be cause for rejection of the concrete.
 - 2. Temperature: The concrete temperature may be checked at the discretion of the Engineer.
 - 3. Entrained air: Air content of the concrete will be checked by a representative of the testing laboratory at the discretion of the Engineer.
- C. Coordination of laboratory services: The Contractor shall be responsible for coordination of laboratory services.
 - 1. Maintain a log recording quantities of each type of concrete placed, date and location of pour.
 - 2. Inform the testing laboratory of locations and dates of concrete placement and other information as required to be identified in the laboratory's test reports.
- D. Tests required because of extensive honeycombing, poor consolidation of the concrete or any suspected deficiency in the concrete will be paid for by the Contractor.
- E. Dimensional tolerances:
 - 1. Dimensional tolerances for allowable variations from dimensions or locations of concrete work, including the locations of embedded items shall be as given in ACI 301.
 - 2. Where anchor bolts or other embedded items are required for equipment installation, comply with the manufacturer's tolerances if more stringent than those stated in ACI 301.
- F. Watertight concrete:
 - 1. All liquid containing structures, basements or pits below grade shall be watertight.
 - 2. Any visible leakage or seepage shall be repaired as instructed by the Engineer at no expense to the Owner.
 - 3. Where physical evidence of honeycombing, cold joints or other deficiencies which may impair the watertightness of a structure exists, the Engineer may at his discretion call for leak testing of the structure.
 - a. Fill the structure with water and allow to stand for not less than 48 hours.
 - b. Make repairs on the structure until all visible leaks are sealed and the leakage rate of the water in the structure is less than 0.1% of the volume held in the structure per day.

- c. The cost of testing and repairs shall be performed at no expense to the Owner.
- G. Concrete which fails to meet strength requirements, dimensional tolerances, watertightness criteria, or is otherwise deficient due to insufficient curing, improper consolidation or physical damage shall be replaced or repaired as instructed by the Engineer at no expense to the Owner.

3.12 MEASUREMENT AND PAYMENT

- A. No measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

SECTION 03 30 02
CONCRETE CURB AND GUTTER, AND SIDEWALK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide cast-in-place concrete, including formwork, where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Reference standards: Comply with the following codes, specifications and standards, except as otherwise shown or specified:
 - 1. American Concrete Institute (ACI) Publications:
 - ACI 305 Recommended Practice for Hot Weather Concreting
 - ACI 306 Recommended Practice for Cold Weather Concreting
 - 2. American Society for Testing and Materials (ASTM) Publications:
 - A 185 Welded Steel Wire Fabric for Concrete Reinforcement
 - C 31 Making and Curing Concrete Test Specimens in the Field
 - C 33 Concrete Aggregates
 - C 39-72 Compressive Strength of Cylindrical Concrete Specimens
 - C 94 Ready-Mixed Concrete
 - C 150 Portland Cement
 - C 260 Air-Entraining Admixtures for Concrete
- C. Testing agency: A testing laboratory will be retained by the Owner to perform material evaluation tests required by these specifications.
- D. Qualifications of contractors performing concrete work: Minimum of two (2) years experience on comparable concrete projects.
- E. Plant qualification: Plant equipment and facilities shall meet all requirements of the Check List for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association and ASTM C 94.

1.3 SUBMITTALS

- A. Comply with the pertinent provisions of Section 01 33 01.

- B. Within 15 calendar days after receiving the Owner's Notice to Proceed, submit proposed mix designs for approval.
 - 1. Proportions shall be determined by means of laboratory tests of concrete made with the cement and aggregate proposed for use.
 - 2. Provide report in detail from an approved testing laboratory showing 7-day and 28-day strengths obtained using materials proposed.
 - 3. Required average strength above specified strength:
 - a. Determinations of required average strength above specified strength (f_c) shall be in accordance with ACI 318 and ACI 301.
 - 4. Cost of this work shall be borne by the Contractor.
- C. Manufacturer's data: Submit manufacturer's specification with application instructions for proprietary materials and items, including curing compound, form release agents, admixtures, patching compounds, and others as required by the Engineer.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 60 01.

PART 2 - PRODUCTS

2.1 FORMS

- A. Use form materials conforming to ACI 347.
- B. Form coatings: Form release coating shall be neat oil with surface wetting agent or chemical release agent which effectively prevents absorption of moisture, prevents bonding with concrete, is non-staining to concrete and leaves the concrete with a paintable surface.
 - 1. On surfaces to receive an applied coating, use a residual free chemical form release agent that is compatible with the applied coating and will not prevent the applied finish from satisfactorily bonding to the concrete.

2.2 SIDEWALK REINFORCEMENT

- A. Fiber reinforcing:
 - 1. Use fiber reinforcing where indicated on the drawings.
 - 2. Provide polypropylene or co-polymer fibers as manufactured by High Tech Fibers, Inc., Fibermesh Company or an approved equal.
 - 3. Where required, use fiber reinforcing at a rate of 2.0 lbs. per cubic yard unless another rate is indicated on the drawings.
- B. Provide welded wire mesh for sidewalk reinforcement in compliance with ASTM A 185.

2.3 PREMOLDED JOINT FILLERS

- A. In concrete pavements (exterior) and concrete sidewalks, use self-expanding cork joint fillers complying with ASTM 1752, Type III.

2.4 CONCRETE MATERIALS

- A. Cement: Use portland cement: ASTM C 150, Type I, Type I-P or Type II, low alkali.
- B. Aggregates:
 - 1. Fine aggregate: Conform to ASTM C 33.
 - 2. Coarse aggregate: Conform to ASTM C 33, Size #57.
- C. Water: Clean and potable and free from injurious amounts of deleterious materials.
- D. Admixtures:
 - 1. Air entraining admixture: ASTM C 260.
 - 2. Water reducing, set controlling admixture: Conform to ASTM C 494.
 - a. Type A - water reducing.
 - b. Type D - water reducing and retarding.
 - 3. Do not use admixtures containing calcium chloride.
- E. Curing compounds:
 - 1. On all vertical and formed surfaces and construction joints, use a non-residual, non-staining curing compound conforming to ASTM C 309 Type 1 and 1D. Acceptable products are:
 - a. L&M Cure by L&M Construction Chemicals, Inc.
 - b. Horn WB-75 by A.C. Horn Company.
 - c. Sonosil by Sonneborn, Inc.
 - d. Approved equal.

2.5 CONCRETE MIXES

- A. Provide concrete with the compressive strength of 4000 psi for a 28-day strength as minimum:
- B. Entrained air: 4000 psi concrete, 5% $\pm$ 1%.
- C. Slump: 4000 psi concrete, 4" $\pm$ 1".
- D. Production of concrete:
 - 1. General: Concrete shall be ready mixed and shall be batched, mixed and transported in accordance with ASTM C 94 except as otherwise indicated.
 - 2. Monitor time and mix proportions by plant delivery slips.
 - 3. Air-entraining admixtures: Add air-entraining admixture into the mixture as a solution and measure by means of an approved mechanical dispensing device.
 - 4. Water reducing and retarding admixture: Add water reducing and retarding admixture and measure as recommended by the manufacturer.
 - 5. Addition of water to the mix upon arrival at the job site shall not exceed that necessary to compensate for a 1" loss in slump, nor shall the design maximum water-cement ratio be exceeded. Water shall not be added to the batch at any later time.
 - 6. Weather conditions: Control temperature of mix as required by ACI 306 "Cold Weather Concreting" and by ACI 305 "Hot Weather Concreting".

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Water, mud, organic, and other detrimental material shall be removed from excavations before concrete is deposited.
- C. Notify the Engineer prior to placing concrete and place no concrete until the formwork, reinforcing and embedded items have been inspected by the Engineer.

3.2 FORMWORK

- A. General:
 - 1. Construct forms in conformance with ACI 347.
 - 2. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement.
 - 3. Coat form contact surfaces with approved form coating compound prior to placing reinforcing steel.
- B. Formwork reuse: Reuse only forms that are in good condition and which maintain a uniform surface texture on exposed concrete surfaces.
 - 1. Apply a light sanding as necessary to obtain a uniform texture.
- C. Removal of forms:
 - 1. Do not disturb or remove forms until the concrete has hardened sufficiently to permit form removal with complete safety.
 - 2. Exercise care in removing forms from finished concrete surfaces so that surfaces are not marred or gouged and that corners are true, sharp and unbroken.
 - 3. Whenever the formwork is removed during the curing period, continue to cure the exposed concrete by one of the methods specified herein.

3.3 PLACING CONCRETE

- A. Preparation:
 - 1. Remove foreign matter accumulated in the forms.
 - 2. Rigidly close openings left in the formwork.
 - 3. Wet wood forms sufficiently to tighten up cracks. Wet other material sufficiently to maintain workability of the concrete.
 - 4. Use only clean tools.
 - 5. Provide and maintain sufficient tools and equipment on hand to facilitate uninterrupted placement of the concrete.
 - 6. Before commencing concrete, inspect and complete installation of formwork and wire mesh.

- B. Conveying:
1. Transport and handle concrete from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete.
 2. Provide equipment for lifting, dumping, chuting, pumping or conveying the concrete, of such size and design as to ensure a practically continuous flow of concrete at the delivery and without separation of materials.
 3. Do not use concrete that is not placed within 1½ hours after water is first introduced into the mix unless the slump is such that it meets the specified limits without the addition of water to the batch.
- C. Placing:
1. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to rehandling and flowing.
 2. Place concrete at such a manner that concrete upon which fresh concrete is deposited is still plastic.
- D. Hot weather placement: Place concrete in hot weather in accordance with ACI 305 "Hot Weather Concreting" and as specified herein.
1. Do not place concrete whose temperature exceeds 100°F.
 2. Thoroughly wet forms and reinforcing prior to placement of concrete.
 3. Use additional set retarder as necessary to increase set time.
 4. Start curing as soon as the concrete is sufficiently hard to permit without damage.
- E. Cold weather placement: Place concrete in cold weather in accordance with ACI 306 and as specified herein.
1. Do not place concrete when the atmospheric temperature is below 40°F.
 2. Do not add salts, chemicals, or other materials to the concrete mix to lower the freezing point of the concrete.
- F. Consolidation:
1. Consolidate each layer of concrete immediately after placing, by use of internal concrete vibrators supplemented by hand spading, rodding, or tamping.
 - a. Use vibrators having a 2" head diameter and a minimum frequency of 8000 vibrations per second.
 - b. Provide sufficient number of vibrators to properly consolidate the concrete, keeping up with placement operations.
 - c. Provide at least one spare vibrator on site.
 2. Insert and withdraw vibrators at points approximately 18" apart.
 3. Do not vibrate forms.
 4. Do not use vibrators to transport concrete inside the forms.

3.4 PROTECTION

- A. Protect the surface finish of newly placed concrete from damage by rainwater or construction traffic.
- B. Do not apply design loads to structures until the concrete has obtained the specified strength.

3.5 CURING

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures and mechanical injury.
- B. Curing compound: Apply curing compound immediately after completion of the finish on uniformed surfaces and within two hours after removal of forms on formed surfaces.
 - 1. Spray the entire surface with two coats of liquid curing compound, applying the second coat in the direction of 90° to the first coat.
 - 2. Apply compound in accordance with the manufacturer's instructions to cover the surface with a uniform film that will seal thoroughly.

3.6 CONCRETE FINISHING

- A. Finish schedule: Unless otherwise indicated on the drawings, finish all concrete surfaces in accordance with the following schedule:
 - 1. Form finish: Formed surfaces not ordinarily exposed to view, including the underside of slabs not exposed to view.
 - 2. Broom finish: Exterior, outdoor slabs exposed to view including:
 - a. Outdoor floor slabs and walkways.
 - b. Other floors which may become wet or otherwise require a non-skid surface.
 - c. Sidewalks and concrete pavements.
 - 3. Edge finish: Exposed edges of slabs not receiving chamfer including:
 - a. Sidewalk edges and joints.
 - b. Pavement edges and joints.
 - c. Other slab edges not chamfered.
- B. Finishing procedures:
 - 1. Form finish:
 - a. Repair defective concrete.
 - b. Fill depressions deeper than 1/4".
 - c. Fill tie holes.
 - d. Remove fins exceeding 1/8" in height.
 - 2. Broom finish:
 - a. Float finish as specified herein.
 - b. Provide a scored texture by drawing a broom across the surface.
 - 3. Edge finish: Tool slab edges and joints with a 1/4" radius edging tool.

3.7 SURFACE REPAIR

- A. Patching mortar:
 - 1. Make a patching mortar consisting of 1 part portland cement to 2-1/2 parts sand by damp loose volume.
 - 2. Mix the mortar using one part acrylic bonding admixture to two parts water.
- B. Surface defects:
 - 1. Remove all defective concrete down to sound solid concrete.
 - 2. Chip edges perpendicular to the concrete surface or slightly undercut, allowing no feathered edges.
 - 3. Dampen surfaces to be patched.
 - 4. Patch defects by filling solidly with repair mortar.

- C. Allow the Engineer to inspect the work before placing the patching mortar.
- D. Repair defective areas greater than 1 sq. ft. or deeper than 1-1/2" as directed by the Engineer using materials approved by the Engineer at no additional expense to the Owner.

3.8 JOINTS

- A. Construction joints:
 - 1. Unless otherwise approved by the Engineer, provide construction joints every ten (10) feet, or as shown on the drawings.
 - 2. Continue all reinforcing across construction joints and provide 1-1/2 " deep keyways unless indicated otherwise on the drawings.
- B. Expansion joints: Provide 1/2" expansion joints with premolded joint filters every thirty (30) feet.

3.9 FIELD QUALITY CONTROL

- A. Concrete cylinder tests:
 - 1. During construction, prepare test cylinders for compressive strength testing, using 6" diameter by 12" long single use molds, complying with ASTM C 31.
 - a. Make a set of three test cylinders from each pour.
 - b. Identify each and tag cylinder as to date of pour and location of concrete which it represents.
 - c. Deliver cylinders to testing lab selected by the Owner.
 - d. Cost for preparation and delivery of cylinders shall be borne by the Contractor. Cost for testing cylinders will be borne by the Owner.
 - 2. Should strengths shown by test cylinders fail to meet specified strengths for the concrete represented, then:
 - a. Engineer shall have the right to require changes in the mix proportions as he deems necessary on the remainder of the work.
 - b. Additional curing of those portions of the structure represented by the failed test cylinders shall be accomplished as directed by the Engineer.
 - c. Upon failure of the additional curing to bring the concrete up to specified strength requirements, strengthening or replacement of those portions of the structure shall be as directed by the Engineer.
 - d. The Engineer may require additional testing of concrete in question by either non-destructive methods such as the Swiss Hammer, Windsor Probe or Ultrasonics or by coring and testing the concrete in question in accordance with ASTM C 42. Such testing shall be performed at no additional cost to the Owner.
- B. Other field concrete tests:
 - 1. Slump tests: Either the Engineer or a testing laboratory representative will make slump tests of concrete as it is discharged from the mixer.
 - a. Slump test may be made on any concrete batch at the discretion of the Engineer.
 - b. Failure to meet specified slump requirements will be cause for rejection of the concrete.

2. Temperature: The concrete temperature may be checked at the discretion of the Engineer.
 3. Entrained air: Air content of the concrete will be checked by a representative of the testing laboratory at the discretion of the Engineer.
- C. Coordination of laboratory services: The Contractor shall be responsible for coordination of laboratory services.
1. Maintain a log recording quantities of each type of concrete placed, date and location of pour.
 2. Inform the testing laboratory of locations and dates of concrete placement and other information as required to be identified in the laboratory's test reports.
- D. Tests required because of extensive honeycombing, poor consolidation of the concrete or any suspected deficiency in the concrete will be paid for by the Contractor.
- E. Dimensional tolerances for allowable variations from dimensions or locations of concrete work, including the locations of embedded items shall be as given in ACI 301.
- F. Concrete which fails to meet strength requirements, dimensional tolerances, watertightness criteria, or is otherwise deficient due to insufficient curing, improper consolidation or physical damage shall be replaced or repaired as instructed by the Engineer at no expense to the Owner.

END OF SECTION

**SECTION 042200
CONCRETE UNIT MASONRY**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative insulated concrete masonry units.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry joint reinforcement.
6. Ties and anchors.

1.2 DEFINITIONS

- A. CMUs: Concrete masonry units.
- B. DICMUs: Decorative insulated concrete masonry units.
- C. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
1. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
- C. Samples for Verification: For each type and color of the following:
1. DICMUs.
 2. Colored mortar.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Integral water repellant used in DICMUs.
 3. Cementitious materials. Include name of manufacturer, brand name, and type.
 4. Mortar admixtures.
 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 6. Grout mixes. Include description of type and proportions of ingredients.
 7. Reinforcing bars.
 8. Joint reinforcement.
 9. Anchors, ties, and metal accessories.

- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

1.6 QUALITY ASSURANCE

- A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 - 1. Build sample panels for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness.
 - 2. Build sample panels facing south.
 - 3. Protect approved sample panels from the elements with weather-resistant membrane.
 - 4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Coordinate mockup with Section 014339 for integrated mockup panel, and as specified in Section 133419.
 - 3. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect 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 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, 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 both sides of walls, and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such 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 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

- 1. Note: Masonry cement mortar is not allowed on this project.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 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 in the standard. Do not use units where such defects will be exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide bullnose units for outside corners of interior CMU unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exterior exposed units.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength.
 - a. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours.
 - 1) No visible water or leaks on the back of test specimen.
 - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour.

- 3) No more than 25 percent of wall area above flashing visibly damp at end of test.
2. Integral water repellent for CMU, mortar, and grout shall be by a single manufacturer.
- C. Insulation Inserts for DICMUs: UL Listed, non-toxic, specially shaped, molded-polystyrene insulation inserts complying with ASTM C578, Type I, designed for installing in cores of masonry units.
1. Basis-of-Design Product: Molded expanded polystyrene (EPS) inserts as manufactured by Omni Block, Inc.
 2. R-value: 4 per inch.
 3. Fluted for moisture migration.
 4. Designed to fit into Omni Block cavities.
 5. Inserts are to include non-mortar interfering indents, vertically and horizontally.
- D. CMUs: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 2. Density Classification: Lightweight.
- E. DICMUs: ASTM C90.
1. Basis-of-Design Product: Integrally colored pre-finished architectural Omni Block as distributed by Old Castle APG-Adams.
 2. Block Design:
 - a. Sizes: Manufactured to dimensions indicated on the drawings.
 - b. No direct cross webs (thermal paths) except at corners, window and door jambs, and control joints.
 - c. Offset cross webs shall create two rows of cells (interior and exterior) for the 8 by 8 by 16 inch units that are individually filled with the insulation inserts.
 3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 4. Density Classification: Lightweight.
 5. Pattern and Texture: Refer to the Exterior Finish Schedule on the drawings.
 - a. Exterior: Standard pattern, split-face finish.
 - b. Interior: Standard smooth face.
 6. Colors: Refer to the Exterior Finish Schedule on the drawings.

2.5 MASONRY LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- B. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- C. 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.
- D. Aggregate for Mortar: ASTM C 144.
- E. Aggregate for Grout: ASTM C 404.
- F. Water-Repellent Admixture: Liquid water-repellent mortar and grout admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- G. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M.
 - 1. Interior Walls: Mill- galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch diameter.
 - 5. Wire Size for Veneer Ties: 0.148-inch diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.8 TIES AND ANCHORS

- A. 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.

- B. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
 - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A153M.
- C. Partition Top anchors: 0.105-inch- thick metal plate with 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

2.9 EMBEDDED FLASHING MATERIALS

- A. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Mortar Net Solutions; Blockflash.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene or urethane.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

2.11 MORTAR AND GROUT 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. For reinforced masonry, use portland cement-lime mortar.
- 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, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other

ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments does not exceed 10 percent of portland cement by weight.
2. Mix to match Architect's sample.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.

E. Grout for Unit Masonry: Comply with ASTM C 476, with water repellent additive.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.
4. Where grout cells are less than 4 inches in diameter, fine grout shall be used.

2.12 MASONRY CLEANERS

- A. Proprietary Buffered 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

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.

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.

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 head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 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. 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.
- C. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. 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.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.5 MASONRY-CELL FILL INSTALLATION

- A. Install molded-polystyrene insulation units into masonry unit cells in accordance with manufacturer's recommendations.
 - 1. In general, inserts are to be installed after units are laid and prior to placing grout in reinforced cells.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.8 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 16 inches for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 FLASHING

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
- B. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions.
 - 1. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall.
 - 2. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.10 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened

sufficiently to carry their own weight and other loads that may be placed on them during construction.

- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.11 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 meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.12 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. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- C. 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. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
3. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

- A. 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.
- B. Excess Masonry Waste: Remove excess clean masonry waste and legally dispose of off Owner's property.

END OF SECTION 042200

**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/ft² 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/yd², 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 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.
 - 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. BASF Construction Chemicals-Building Systems: www.chemrex.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Polyurethane Sealants:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Pecora Corporation: www.pecora.com.
 - 3. BASF Construction Chemicals-Building Systems: www.chemrex.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Acrylic Sealants (ASTM C920):
 - 1. Tremco Global Sealants: www.tremcosealants.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

- D. Butyl Sealants:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Pecora Corporation: www.pecora.com.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Acrylic Emulsion Latex Sealants:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Pecora Corporation: www.pecora.com.
 - 3. BASF Construction Chemicals-Building Systems: 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.
 - 2. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
 - 3. Dayton Superior Corporation: 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.
 - 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 14 16 FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush configuration; non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 06 20 00 - Finish Carpentry.
- B. Section 08 11 13 - Hollow Metal Doors and Frames.
- C. Section 08 71 00 - Door Hardware.
- D. Section 08 80 00 - Glazing.
- E. Sections 09 91 13 and 09 91 23 - Painting and Coating: Site finishing of doors.

1.03 REFERENCE STANDARDS

- A. WDMA I.S.1-A - Architectural Wood Flush Doors; Window and Door Manufacturers Association; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Specimen warranty.
- D. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, factory machining criteria, factory finishing criteria, identify cutouts for glazing and louvers.
- E. Samples: Submit two samples of door veneer, 12" by 12" inch in size illustrating wood grain, stain color, and sheen.
- F. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Eggers Industries: www.eggersindustries.com.
 - 2. Haley Brothers: www.haleybros.com.
 - 3. Algoma Hardwoods, Inc..
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS

- A. All Doors: See drawings for locations and additional requirements.
 - 1. Quality Level: Custom Grade, Extra Heavy Duty performance, in accordance with WDMA I.S.1-A.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at all locations.
 - 2. Wood veneer facing with factory transparent finish.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type staved lumber core (SLC), plies and faces as indicated above.

2.04 DOOR FACINGS

- A. Wood Veneer Facing for Transparent Finish: White birch, veneer grade as specified by quality standard, plain sliced, pleasing veneer match, running assembly match; unless otherwise indicated.
 - 1. Vertical Edges: Any option allowed by quality standard for grade.
 - 2. Pairs: Pair match each pair; set match pairs within 10 feet of each other when doors are closed.

2.05 ACCESSORIES

- A. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style screws.

2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Fit door edge trim to edge of stiles after applying veneer facing.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

- A. Factory finish doors in accordance with the selected manufacturer's standard colors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.
- F. Install door louvers plumb and level.

3.03 TOLERANCES

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.05 SCHEDULE - SEE DRAWINGS

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: 12 by 12 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.
- 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 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Deleted.
- C. Weatherstripping.
- D. Deleted.
- E. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Perimeter air and vapor seal between glazing system and adjacent construction.
- B. Section 07 90 05 - Joint Sealers: Perimeter sealant and back-up materials.
- C. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2012.
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2010.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.
- E. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- F. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002 (Reapproved 2010).
- G. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting 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. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

1.06 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a 10 year period after Date of Substantial Completion.
- C. Provide 10 year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN – FRAMING FOR INSULATING GLAZING (SF1)

- A. Center-Set Style, Thermally-Broken:
 - 1. Basis of Design: Kawneer North America; Trifab 451 UT: www.kawneer.com/#sle.
 - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).
- B. Substitutions: See Section 01 60 00 – Product Requirements.
 - 1. For any product not identified as “Basis of Design”, submit information as specified for substitutions.

2.02 BASIS OF DESIGN – FRAMING FOR MONOLITHIC GLAZING (SF2)

- A. Center-Set Style:
 - 1. Basis of Design: Kawneer North America; Trifab 450: www.kawneer.com/#sle.
 - 2. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep (44 mm wide by 114 mm deep).
- B. Substitutions: See Section 01 60 00 – Product Requirements.
 - 1. For any product not identified as “Basis of Design”, submit information as specified for substitutions.

2.03 BASIS OF DESIGN – SWINGING DOORS

- A. Exterior Door sin SF1 Frames – Wide Stile, Insulating Glazing, Thermally-Broken:
 - 1. Basis of Design: Kawneer North America; 560 Insulclad Series with 10 inch bottom rail: www.kawneer.com/#sle.
 - 2. Thickness: 2-1/4 inches (57.1 mm)
- B. Substitutions: See Section 01 60 00 – Product Requirements.
 - 1. For any product not identified as “Basis of Design”, submit information as specified for substitutions.

2.04 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, related flashings, anchorage and attachment devices.
 - 1. Unitized, shop assembly.

2. Glazing Rabbet: For 1 inch insulating glazing at all exterior window units; 5/8 inch insulating glazing at all entrances and 1/4 inch at interior locations as scheduled.
 3. Glazing Position: Centered (front to back).
 4. Vertical Mullion Dimensions: 2 inches wide by 4.5 inches deep for exterior, 1-3/4 inches wide by 4.5 inches deep for interior.
 5. Sill Pan: Provide sill pan accessory at all exterior storefront openings. Type, finish and color to match framing members.
 6. Finish: High performance organic coating.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 7. Finish Color: Bone White.
 8. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 9. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 10. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 11. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 12. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 13. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8.00 lbf/sq ft.
 3. Air Leakage: Maximum of 0.06 cu ft/min/sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 pounds per square foot pressure differential across assembly.
 4. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
 5. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283.
 6. Water Leakage: None, when measured in accordance with ASTM E331 at specified pressure differential.
 7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without

causing detrimental effect to system components, anchorages, and other building elements.

2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Glazing stops: Flush.
- B. Glazing: As specified in Section 08 80 00.
- C. Swing Doors: Glazed aluminum.
 - 1. Finish: Same as storefront.

2.06 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Perimeter Sealant: As specified in Section 07 90 05.
- D. Glass: As specified in Section 08 80 00.
- E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.07 FINISHES

- A. High Performance Organic Finish: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
- B. Color: To be selected by Architect from manufacturer's full range.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.08 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

2.09 HARDWARE

- A. For each door, include all necessary components for intended door operation and function to include weathertight seal on exterior doors.
- B. Door Hardware Finish, unless noted otherwise: #14m Clear Anodized.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all exterior doors.
- D. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all exterior doors.
- E. Threshold: ADA compliant, extruded aluminum, one piece per door opening, ribbed surface, for butt hung doors; provide on all exterior doors.

- F. Hinges: Offset Pivots, Provide EL (electric transfer model) on doors noted on drawings for security access control; top, intermediate, and bottom. Finish: Powder coated to match door panel finish.
- G. Power Supply: SP-1000x.
- H. Push/Pull Sets: Architect's Classic Series - Pull: CO-12; Push Bar: CP-II.
1. Provide on doors not requiring exit devices.
 2. Provide Pull Handle only on doors with exit devices.
- I. Exit Devices - Double Doors: Adams Rite 8600 Concealed Vertical Rod; Finish - Clear anodized.
- J. Exit Devices - Single Doors: Adams Rite 8400 Mortise Device; provide with Adams Rite 4900 Series Deadlatch; Finish - Clear Anodized.
- K. Door Closers: Norton 1601, Parallel Arm Mounting.
- L. Strikes: Adams Rite, Standard Latch Strike .
- M. Locks: SFIC Compatible; keyed cylinder outside.
- N. Security Access Control: By others. Coordinate materials and installation with security company, storefront/hardware supplier, and electrical subcontractor to ensure all parts are compatible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of mastic and secure.
- K. Install hardware using templates provided.
- L. Install glass and infill panels in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- M. Install perimeter sealant in accordance with Section 07 90 05.

- N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 56 59
SERVICE AND TELLER WINDOW UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Service and teller window units.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate work with adjacent materials specified in other sections and as indicated on drawings and approved shop drawings.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's product data for specified products indicating materials, operation, glazing, finishes, and installation instructions.
- C. Shop Drawings: Indicate configuration, sizes, rough-in, mounting, anchors and fasteners, and installation clearances.
- D. Manufacturer Qualification Statement.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications: Company specializing in manufacturing products specified in this section with at least ten years documented experience, and with ability to provide test reports showing that their standard manufactured products meet the specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units in manufacturer's original packaging and unopened containers with identification labels intact.
- B. Store units in area protected from exposure to weather and vandalism.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty agreeing to repair or replace units and their components that fail in materials or workmanship within five years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Service and Teller Window Units:
 - 1. C.R. Lawrence Company, www.crlawrence.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SERVICE AND TELLER WINDOW UNITS

- A. Location: Built within interior wall, as indicated on drawings.
- B. Type of Use: Walk-up.
- C. Window Type: Frameless Pass-Thru.
 - 1. Operation: Manual.
 - 2. Mounting: Flush with wall surface.
 - 3. Window Size: As indicated on drawings.
 - 4. Material: Aluminum.

- a. Finish: Satin Anodized.
- D. Glazing: Single (monolithic), ¼ inch thick, clear.
 - 1. Tempered safety glazing.
- E. Products:
 - 1. CRL Sharyn Frameless Pass-Thru Window, XX Configuration, Keyed Lock.
 - 2. Substitutions: See Section 01 60 00 – Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that window openings are ready for installation of windows.
- B. Notify Architect if conditions are not suitable for installation of units; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install units in correct orientation (inside/outside or secure/non-secure).
- C. Anchor units securely in manner so as to achieve performance specified.

3.03 ADJUSTING

- A. Adjust operating components for smooth operation while also maintaining a secure, weather-tight enclosure and a tight fit at the contact points; lubricate opening hardware.

3.04 CLEANING

- A. Remove protective material from factory finished surfaces.
- B. Clean exposed surfaces promptly after installation without damaging finishes.

3.05 PROTECTION

- A. Provide temporary protection to ensure that service and teller windows are without damage upon Date of Substantial Completion.

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.

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 80 00
GLAZING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealers: Sealant and back-up material.
- B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed doors and borrowed lites.
- C. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.
- D. Section 08 43 13 - Aluminum-Framed Entrances: Glazing furnished by storefront manufacturer.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.
- D. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2011a.
- G. GANA (SM) - GANA Sealant Manual; Glass Association of North America; 2008.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit two samples 12 x 12 inch in size of glass units, showing coloration.
- E. Certificates: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 10 years documented experience.

1.06 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 GLAZING TYPES

- A. GL-1 - Sealed Insulating Glass Units:
 - 1. Application(s): All exterior glazing unless otherwise indicated.
 - 2. Outboard Lite: Annealed float glass, 1/4 inch thick Sunguard SuperNeutral SNX 62/27 as manufactured by Guardian Industries or approved equal.
 - a. Tint: Crystal Gray.
 - b. Coating: Low-E type, on #2 surface.
 - 3. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - 4. Total Thickness: 1 inch.
 - 5. Glazing Method: Gasket glazing.
- B. Type GL-1S - Sealed Insulating Glass Units: Safety glazing:
 - 1. Applications: Provide this type of glazing in the following locations:
 - a. Glazed sidelights and panels next to doors and glass in doors.
 - b. 5/8 " thick Low E insulated similar to Type GL-1.
 - b. Other locations required by applicable federal, state, and local codes and regulations.
 - c. Other locations indicated on the drawings.
 - 2. Type: Same as other vision glazing except use fully tempered float glass for both outboard and inboard lites.
 - 3. Tint: to match other tints specified for insulated glass units.
- C. Type GL-2 - Single Safety Glazing: Non-fire-rated.
 - 1. Applications: Provide this type of glazing in the following locations:
 - a. Glazed lites in doors, except fire doors.
 - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on the drawings.
 - 2. Type: Fully tempered float glass as specified.
 - 3. Tint: Clear.
 - 4. Thickness: 1/4 inch.

2.02 GLASS MATERIALS

- A. Float Glass Manufacturers:
 - 1. Basis of Design: Guardian Industries or Approved Equal.
 - 2. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- B. Float Glass: All interior glazing is to be float glass unless otherwise indicated.
 - 1. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
 - 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048.
 - 3. Tinted Types: Color and performance characteristics as indicated.
- C. Safety Glass: Clear; fully tempered with horizontal tempering.
 - 1. Laminated with 0.030 inch thick plastic interlayer; comply with ASTM C 1172
 - 2. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
 - 3. Comply with 16 CFR 1201 test requirements for Category II.
 - 4. 6 mm minimum thick.
 - 5. Provide this type of glazing in the locations required by code.

2.03 GLAZING COMPOUNDS

- A. Manufacturers:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 3. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- B. Butyl Sealant: Single component; ASTM C 920, Grade NS, Class 12-1/2, Uses M and A; Shore A hardness of 10 to 20; black color; non-skinning.
- C. Silicone Sealant (Type see Section 07900): Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

2.04 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option I; black color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- E. Install sealant in accordance with manufacturer's instructions.

3.03 GLAZING METHODS

3.04 INSTALLATION - EXTERIOR DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- E. Trim protruding tape edge.

3.05 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

- C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- D. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
- E. Fill gaps between pane and applied stop with manufacturer provided sealant to depth equal to bite on glazing, to uniform and level line.
- F. Trim protruding tape edge.

3.06 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

3.07 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

3.08 SCHEDULE

- A. Metal-Framed Storefronts and Entrances: Refer to drawings.

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.
 - 2. Georgia-Pacific Gypsum: www.gpgypsum.com.
 - 3. National Gypsum Company: www.nationalgypsum.com.
 - 4. USG Corporation: 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 e² 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 30 00

TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Installation of tile backer board.

1.03 REFERENCE STANDARDS

- A. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2013.1.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting 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. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Tile: 2 percent of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.01 PORCELAIN TILE

- A. Manufacturers: As indicated on the Finish Schedule on the drawings.
 - 1. Substitutions: None.

2.02 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
 - 1. Applications: Use in the following locations:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Coved.
 - c. Floor to Wall Joints: Cove base.
 - 2. Manufacturer: Same as for tile.

- B. Thresholds: Marble, white, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.

2.03 SETTING MATERIALS

- A. Provide setting materials made by the same manufacturer as grout.
- B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
 - 1. Application(s): Use this type of bond coat where indicated and where no other type of bond coat is indicated.

2.04 ADHESIVE MATERIALS

- A. Manufacturers:
 - 1. Bonsal American, Inc: www.sakrete.com
 - 2. Bostik Inc: www.bostik-us.com.
 - 3. Mapei Corporation: www.mapei.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 GROUTS

- A. Manufacturers:
 - 1. Custom Building Products: www.custombuildingproducts.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Standard Grout: ANSI A118.6 standard cement grout.
 - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): As scheduled.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and The Tile Council of North America Handbook recommendations.
- B. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- C. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- D. Form internal angles square and external angles bullnosed.
- E. Install thresholds where indicated.
- F. Sound tile after setting. Replace hollow sounding units.
- G. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- H. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- I. Grout tile joints.
- J. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install in accordance with The Tile Council of North America Handbook Method W244.
- B. Over interior concrete and masonry install in accordance with TCA Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.

3.05 CLEANING

- A. Clean tile and grout surfaces.

3.06 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 51 16
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCE STANDARDS

- A. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2007.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2008.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2011.
- E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2008e1.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples 3 x 3 inch in size illustrating material and finish of acoustical units.

1.05 QUALITY ASSURANCE

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

1.06 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc;
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Acoustical Units - General: ASTM E1264, Class A.
- C. Acoustical Panels: As indicated on Drawings.

2.02 SUSPENSION SYSTEM(S)

- A. Manufacturers:

1. Same as for acoustical units.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Suspension Systems - General: ASTM C635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; intermediate-duty.
1. Profile: Tee; 15/16 inch (24 mm) wide face.
 2. Finish: White painted.

2.03 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches (150 mm) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Use longest practical lengths.
 2. Overlap and rivet corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.

- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.

3.04 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

**SECTION 09 65 16
RESILIENT FLOORING AND BASE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient base.
- B. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 REFERENCE STANDARDS

- A. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2004 (reapproved 2010).
- B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008.
- C. ASTM E 662 - Smoke Density.
- D. ASTM E 648 - Fire Resistance.
- E. ASTM D 204 - Coefficient of Friction.
- F. ASTM F 970 - Static Load.
- G. ASTM F 925 - Chemical Resistance.
- H. ASTM F 410 - Wear Layer Thickness.
- I. ASTM F 386 - Overall Thickness.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plan.
- D. Verification Samples: Submit two samples, 12"x12" inch in size illustrating color and pattern for each resilient flooring product specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect roll materials from damage by storing on end.

1.06 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
 - 1. Height: 6 inch.
 - 2. Thickness: 0.125 inch thick.
 - 3. Finish: Matte.
 - 4. Length: Roll.

5. Color and Type: as indicated on the drawings.
 6. Manufacturers:
 - a. Roppe
 - b. Tarkett
- Substitutions: Permitted

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Verify that concrete sub-floor surfaces are dry enough and ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is cured.
- C. Clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.05 CLEANING

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

3.06 PROTECTION

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

END OF SECTION

**SECTION 09 68 00
TILE CARPETING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet, direct-glued.
- B. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006 (Reapproved 2011).
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- C. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2009.
- D. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.
- E. CRI (GLC) - Green Label Testing Program - Approved Product Categories for Carpet; Carpet and Rug Institute; Current Edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples for verification purposes: Submit a sample of each type of pattern and color of carpet specified.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, & HANDLING

- A. Deliver materials to the project site ready for use, in unopened original factory packaging clearly labeled to identify manufacturer.

1.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.
- B. Ventilate installation area during installation and for 72 hours after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carpet:
 - 1. Product: as indicated on the drawings.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 CARPET

- A. Carpet TILES:
 - 1. Product: as indicated on the drawings.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ACCESSORIES

- A. Sub-Floor Filler: Type recommended by carpet manufacturer.

- B. Moldings and Edge Strips: As indicated on the drawings.
- C. Adhesives - General: Compatible with materials being adhered.
- D. Seam Adhesive: Recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.
- B. Cement/Concrete Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
 - 1. Test in accordance with ASTM F710.
 - 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet in accordance with manufacturer's instructions and CRI Carpet Installation Standard.
- C. Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.
- D. Lay adjoining carpet tiles straight, not overlapped or peaked, and free of gaps.
- E. Roll with appropriate roller for complete contact of adhesive to carpet backing.
- F. Trim carpet neatly at walls and around interruptions.

3.04 CLEANING

- A. Remove excess adhesive from floor and wall surfaces without damage.
- B. Clean and vacuum carpet surfaces.

3.05 PROTECTION

- A. After completing required installation, provide temporary protection until construction traffic has ended and project is near time of substantial completion.

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, brushmarks, 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 where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brushmarks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:

- a. Equipment, including panelboards and switch gear.
 - 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 masonrywork.
- 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-laminatesheet 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-coatfinish 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 21 13.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal screens.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS

- A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 4 by 4 inch (____by____mm) in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
 - 1. Scranton Products; Hiny Hiders Partitions: www.scrantonproducts.com/#sle.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.02 PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
 - 1. Color: Midnight - Orange Peel..
 - 2. Doors:
 - a. Thickness: 1 inch (25 mm).
 - b. Width: 24 inch (610 mm).
 - c. Width for Handicapped Use: 32 inch (____mm), out-swinging.
 - d. Height: 66 inch (____mm).
 - 3. Panels:
 - a. Thickness: 1 inch (25 mm).
 - b. Height: 66 inch (____mm).
 - c. Depth: As indicated on drawings.
 - 4. Pilasters:
 - a. Thickness: 1 inch (25 mm).
 - b. Width: As required to fit space; minimum 3 inch (76 mm).
 - 5. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.03 ACCESSORIES

- A. Pilaster Shoes: 20 gauge stainless steel, 3 inches (____mm) high; concealing Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt. fastenings.
- B. Head Rails: Heavy-duty extruded 6463-T5 alloy aluminum w/ anti-grip design. Clear anodized finish. Fasten to headrail brackets w/ stainless steel tamper resistant Torx head sex bolt, Fasten at the top of pilaster w/ stainless steel tamper resistant Torx head screws,.
- C. Wall and Pilaster Brackets: 20 gauge stainless steel with satin finish; manufacturer's standard type for conditions indicated on drawings.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- E. Hinges: Anodized aluminum; satin finish.
 - 1. Continuous-type hinge, self closing; 65 inches.
- F. Door Hardware: Heavy-duty extruded aluminum 6436-T5 alloy with a bright dip anodized finish; ____ finish.
 - 1. Door Latch: Slide type with Aluminum Slide Bolt Latch and Housing.
 - 2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
 - 3. Equip outswing handicapped doors with second door pull and door stop.
- G. Coat Hook/Bumper: One per compartment, mounted on door.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

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.
 - 2. American Specialties, Inc: www.americanspecialties.com.
 - 3. Bradley Corporation: 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 10 44 00
FIRE EXTINGUISHERS AND CABINETS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2010.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguisher Cabinets and Accessories:
 - 1. JL Industries, Inc: www.jlindustries.com.
 - 2. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 3. Potter-Roemer: www.potterroemer.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Water Type Fire Extinguishers: Stainless steel tank, with granular soda for pressurization, including hose and nozzle.
 - 1. Size and classification as scheduled.
 - 2. Finish: Baked enamel, Red color.
- C. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gage.
 - 1. Size and classification as scheduled.
 - 2. Finish: Baked enamel, red color.

2.03 FIRE EXTINGUISHER CABINETS

- A. Metal: Formed aluminum;
- B. Cabinet Configuration: Semi-recessed and Surface type as indicated in the drawings.
 - 1. Sized to accommodate accessories.
- C. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
- D. Door Glazing: Glass, clear, 1/8 inch thick float. Set in resilient channel gasket glazing.
- E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- F. Weld, fill, and grind components smooth.
- G. Finish of Cabinet Exterior Trim and Door: Satin chrome.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers and accessories in cabinets.

END OF SECTION

**SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Above ground piping.
- B. Buried piping.
- C. Escutcheons.
- D. Expansions - hose and braid.
- E. Fire rated enclosures.
- F. Mechanical couplings.
- G. Pipe hangers and supports.
- H. Pipe sleeves.
- I. Pipe sleeve-seal systems.
- J. Piping specialties.
- K. Pressure gauges.
- L. Pressure relief valves.
- M. Retrofit-sprinkler piping cover system.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07, Firestopping.
- C. Section Division 09, Interior Painting: Preparation and painting of interior fire protection piping systems.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- B. ASME A112.18.1 - Plumbing Supply Fittings; 2024.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- F. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.
- G. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2024.
- H. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2021.
- I. ASME B16.25 - Buttwelding Ends; 2022.
- J. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2022.
- K. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- L. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.

- M. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- O. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.
- P. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- Q. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- S. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- T. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2023.
- U. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2024.
- V. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2023.
- W. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.
- X. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- Y. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- Z. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.
- AA. AWWA C606 - Grooved and Shouldered Joints; 2022.
- BB. FM (AG) - FM Approval Guide; Current Edition.
- CC. FM 1920 - Approval Standard for Pipe Couplings and Fittings for Aboveground Fire Protection Systems; 2007.
- DD. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- EE. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; 2025.
- FF. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2024.
- GG. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- HH. UL 213 - Rubber Gasketed Fittings for Fire-Protection Service; Current Edition, Including All Revisions.
- II. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- JJ. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.
- KK. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

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

- B. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
 - C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Deliver and store valves in shipping containers, with labeling in place.
 - B. Provide temporary protective coating on cast iron and steel valves.
 - C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- 1.06 WARRANTY
- A. See Division 01 Closeout Requirements for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Sprinkler-based System:
 - 1. Comply with NFPA 13.
 - 2. See Section 21 13 00.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.02 BURIED PIPING

- A. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: AWWA C110/A21.10, standard thickness.
 - 2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket.
 - 3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

2.03 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A135/A135M Schedule 10 or ASTM A795 Schedule 40, black.
 - 1. Steel Fittings: ASME B16.5 steel flanges and fittings.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
- B. CPVC Pipe: ASTM F442/F442M, SDR 13.5.
 - 1. Fittings: ASTM F438 Schedule 40, or ASTM F439 Schedule 80, CPVC.
 - 2. Joints: Solvent welded, using ASTM F493 cement.

2.04 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
- B. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc-coated or cast-iron pipe.

2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

2.05 PIPE SLEEVE-SEAL SYSTEMS

- A. Modular Mechanical Seals:
 1. Elastomer-based interlocking links to continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 3. Size and select seal component materials in accordance with service requirements.
 4. Service Requirements:
 - a. Underground, buried, and wet conditions.
 5. Glass-reinforced plastic pressure end plates.
- B. Wall Sleeve: PVC material with waterstop collar, and nailer end caps.
- C. Sleeve-Forming Disk: Nonconductive plastic-based material, 3 inch thick.
- D. Pipeline-Casing Seals:
 1. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

2.06 FIRE-RATED ENCLOSURES

- A. Provide as required to preserve fire resistance rating of building elements.

2.07 ESCUTCHEONS

- A. Material:
 1. Chrome-plated.
 2. Metals and Finish: Comply with ASME A112.18.1.
- B. Construction:
 1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
 2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.08 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Nonmetallic Piping Hangers:
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Vertical Support: Steel riser clamp.

2.09 EXPANSION LOOPS - HOSE AND BRAID

- A. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.

2.10 MECHANICAL COUPLINGS

- A. Rigid Mechanical Couplings for Grooved Joints:
 1. Dimensions and Testing: Comply with AWWA C606.
 2. Minimum Working Pressure: 300 psig.
 3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
 4. Housing Coating: Factory applied orange enamel.
 5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
 6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.

2.11 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
 - 1. Activate electric alarm.
 - 2. Test and drain valve.
 - 3. Replaceable internal components without removing valve from installed position.
- B. Auxiliary Drains: Condensate collection drain for each section of trapped pipe in preaction or dry fire protection system.
- C. Air Venting Valves:
- D. Backflow Preventer: Reduced-pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.
- E. Commercial Riser Manifold: Preassembled and tested riser manifold in accordance with NFPA 13.
- F. Test Connections:
 - 1. Combination Inspector's Test Connection and Drain Valve:
 - a. Provide test connections approximately 6 feet above floor for each or portion of each sprinkler system equipped with an alarm device, located at most remote part of each system.
 - b. Route combination test connection and drain valve to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
 - c. Supply discharge orifice with same size as corresponding sprinkler orifice.
 - d. Limit vertical height of exterior wall penetration to 2 feet above finished grade.
 - 2. Backflow Preventer Test Connection:
 - a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5-inch National Standard male hose threads with cap and chain.
 - b. Provide one valve for each 250 gpm of system demand or fraction thereof.
 - c. Provide permanent sign reading "Test Valve." See Section 21 05 53.
- G. Electric Alarm: Electrically operated red-enameled gong with pressure alarm switch.
- H. Water Flow Switch: Vane-type switch for mounting horizontally or vertically, with two contacts; rated 10 A at 125 VAC and 2.5 A at 24 VDC.
- I. Fire Department Connections:
 - 1. Type: Exposed, projected wall mount made of corrosion-resistant metal complying with UL 405.
 - a. Inlets: Two-way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or authority having jurisdiction. Brass caps with gaskets, chains, and lugs.
 - b. Finish: Brass or bronze.
 - c. Signage: Raised or engraved lettering 1 inch, minimum, indicating system type.
- J. Supervisory Switches:

2.12 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

2.13 PRESSURE RELIEF VALVES

- A. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

2.14 RETROFIT-SPRINKLER PIPING COVER SYSTEM

- A. General Requirements:
 - 1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.
- B. Materials:
 - 1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
 - 2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
 - 3. Provide sidewall sprinkler head housing in compliance with NFPA 13.
 - 4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
 - 5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
 - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 2. Place hangers within 12 inches of each horizontal elbow.
 - 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- H. Structural Considerations:
 - 1. Do not penetrate building structural members unless indicated.
- I. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Aboveground Piping:

- a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 - 2. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Division 07 Firestopping to prevent the spread of fire, smoke, and gases.
 - J. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a watertight seal.
 - 6. Install in accordance with manufacturer's recommendations.
 - K. Escutcheons:
 - 1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
 - 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
 - 3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
 - L. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- 3.03 CLEANING
- A. Upon completion of work, clean all parts of the installation.
 - B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 21 05 23
GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Two-piece ball valves with indicators.
- B. Bronze butterfly valves with indicators.
- C. Iron butterfly valves with indicators.
- D. Check valves.
- E. Bronze OS&Y gate valves.
- F. Iron OS&Y gate valves.
- G. NRS gate valves.
- H. Indicator posts.
- I. Trim and drain valves.

1.02 RELATED REQUIREMENTS

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

1.03 ABBREVIATIONS AND ACRONYMS

- A. EPDM: Ethylene-propylene diene monomer.
- B. NRS: Non-rising stem.
- C. OS&Y: Outside screw and yoke.
- D. PTFE: Polytetrafluoroethylene.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300; 2021.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.
- E. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2024.
- F. AWWA C606 - Grooved and Shouldered Joints; 2022.
- G. FM (AG) - FM Approval Guide; Current Edition.
- H. FM 1110 - Approval Standard for Indicator Posts; 1990.
- I. FM 1112 - Examination Standard for Indicating Valves (Butterfly or Ball Type); 2020.
- J. FM 1120/1130 - Approval Standard for Fire Service Water Control Valves (OS&Y and NRS Gate Valves); 1997.
- K. FM 1140 - Approval Standard for Quick Opening Valves 1/4 Inch through 2 Inch Nominal Size; 1998.
- L. FM 1210 - Approval Standard for Swing Check Valves; 2004.

- M. UL (DIR) - Online Certifications Directory; Current Edition.
- N. UL 258 - Shutoff Valves for Trim and Drain Purposes for Fire Protection Service; Current Edition, Including All Revisions.
- O. UL 262 - Gate Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- P. UL 312 - Check Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- Q. UL 789 - Indicator Posts for Fire-Protection Service; Current Edition, Including All Revisions.
- R. UL 1091 - Standard for Butterfly Valves for Fire-Protection Service; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. Refer to Division 01 for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- C. Where listed products are specified, provide products listed, certified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose indicated.
- D. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect valve ends and flange faces.
 - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors and maintain at higher than ambient dew point temperature.
 - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
- C. Use the following precautions for handling:
 - 1. Use sling to handle large valves, rig to avoid damage to exposed parts.
 - 2. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Source Limitations: Furnish valves of same kind by same manufacturer.
- B. Valve-End Connections:
 - 1. Flanges on Iron Valves: ASME B16.1 or ASME B16.42.
 - 2. Threaded Ends: ASME B1.20.1.
 - 3. Grooved Ends: AWWA C606.
- C. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Hand-lever: For quarter-turn trim and drain valves 2 NPS and smaller.

2.02 TWO PIECE BALL VALVES WITH INDICATORS

- A. UL 1091 and FM 1112 listed.
- B. Description:
 - 1. Minimum Pressure Rating: 175 psig.
 - 2. Body Design: Two piece.
 - 3. Body Material: Forged brass or bronze.
 - 4. Port Size: Full.
 - 5. Seat: PTFE.
 - 6. Stem: Bronze or stainless steel.
 - 7. Ball: Chrome-plated brass.
 - 8. Actuator: Worm gear or traveling nut.
 - 9. Supervisory Switch: Internal or external.
 - 10. End Connections: Threaded or grooved.

2.03 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. UL 1091 and FM 1112 listed.
- B. Minimum Pressure Rating: 175 psig.
- C. Body Material: Bronze.
- D. Seat: EPDM.
- E. Stem: Bronze or stainless steel.
- F. Disc: Bronze with EPDM coating or stainless steel.
- G. Actuator: Worm gear or traveling nut.
- H. Supervisory Switch: Internal or external.
- I. End Connections: Threaded or grooved.

2.04 IRON BUTTERFLY VALVES WITH INDICATORS

- A. UL 1091 and FM 1112 listed.
- B. Minimum Pressure Rating: 175 psig.
- C. Body Material: Cast or ductile iron.
- D. Seat: EPDM.
- E. Stem: Stainless steel.

- F. Disc: Ductile iron with EPDM coating.
 - G. Actuator: Worm gear or traveling nut.
 - H. Supervisory Switch: Internal or external.
 - I. Body Design: Grooved-end or wafer style.
- 2.05 SWING CHECK VALVES
- A. UL 312 and FM 1210 listed.
 - B. Minimum Pressure Rating: 175 psig.
 - C. Body Material: Cast or ductile iron.
 - D. Clapper: Bronze, EPDM-coated ductile iron, or stainless steel.
 - E. Seat: Bronze or EPDM-coated bronze.
 - F. End Connections: Flanged or grooved.
- 2.06 BRONZE SWING CHECK VALVES
- A. MSS SP-80, type 4
 - B. Minimum Pressure Rating: 200 psi
 - C. Body design: Horizontal flow.
 - D. Body Material: ASTM B 62, Bronze
 - E. Clapper: Bronze, EPDM-coated
 - F. Seat: Bronze or EPDM-coated bronze.
 - G. End Connections: Threaded.
- 2.07 BRONZE OS&Y GATE VALVES
- A. UL 262 and FM 1120/1130 listed.
 - B. Minimum Pressure Rating: 175 psig.
 - C. Body and Bonnet Material: Bronze or brass.
 - D. Wedge: One-piece bronze or brass.
 - E. Wedge Seat: Bronze.
 - F. Stem: Bronze or brass.
 - G. Packing: Non-asbestos PTFE.
 - H. Supervisory Switch: External.
 - I. End Connections: Threaded.
- 2.08 IRON OS&Y GATE VALVES
- A. UL 262 and FM 1120/1130 listed.
 - B. Minimum Pressure Rating: 175 psig.
 - C. Body and Bonnet Material: Cast or ductile iron.
 - D. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
 - E. Stem: Brass, bronze, or stainless steel.
 - F. Packing: Non-asbestos PTFE.
 - G. Supervisory Switch: External.
- 2.09 IRON NRS GATE VALVES

- A. UL 262 and FM 1120/1130 listed.
- B. Minimum Pressure Rating: 175 psig.
- C. Body and Bonnet Material: Cast or ductile iron.
- D. Wedge: Cast or ductile iron with elastomeric coating.
- E. Stem: Brass or bronze.
- F. Packing: Non-asbestos PTFE.
- G. Operation:
 - 1. Operating nut for post-indicating valves.
 - 2. Handwheel for non-post-indicating valves.
- H. Post Plate: Provide for post-indicating valves.
- I. End Connections: Flanged.

2.10 INDICATOR POSTS

- A. Underground Indicator Posts:
 - 1. UL 789 and FM 1110 listed, ground-mounted indicator post for operating buried sprinkler-system isolation valves, with fixed or telescoping barrel.
 - 2. Barrel Standpipe Material: Carbon steel or ductile iron.
 - 3. Telescoping Top Barrel for Adjustable Length Indicator Posts: Carbon steel, cast iron, or ductile iron.
 - 4. Top of indicator post shall be 32" to 40" above finish grade.
 - 5. Supervisory Switch: External.
 - 6. Post Head: Cast or ductile iron.
 - 7. Operation: Locking wrench.
 - 8. Finish: AWWA C550 epoxy coating.
- B. Pit Indicator Posts:
 - 1. UL 789 and FM 1110 listed, slab-mounted indicator post for operating inaccessible sprinkler-system isolation valves located in service pits, vaults, or tunnels.
 - 2. Barrel Standpipe Material: Carbon steel or ductile iron.
 - 3. Post Head: Cast or ductile iron.
 - 4. Operation: Locking wrench.
 - 5. Finish: AWWA C550 epoxy coating.
- C. Wall Indicator Posts:
 - 1. UL 789 and FM 1110 listed, wall-mounted indicator post for operating sprinkler-system isolation valves located on opposite side of wall.
 - 2. Body: Cast or ductile iron.
 - 3. Operation: Lockable handwheel.
 - 4. Finish: AWWA C550 epoxy coating.
 - 5. Elevate 36" minimum above finished grade or floor.

2.11 TRIM AND DRAIN VALVES

- A. Ball Valves:
 - 1. Description:
 - a. UL 258 or FM 1140 listed.
 - b. Pressure Rating: 175 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass or bronze.
 - e. Port Size: Full.
 - f. Seat: PTFE.

- g. Stem: Bronze or stainless steel.
 - h. Ball: Chrome-plated brass.
 - i. Actuator: Hand-lever.
 - j. End Connections: Threaded or grooved.
- B. Angle Valves:
- 1. Description:
 - a. UL 258 or FM 1140 listed.
 - b. Pressure Rating: 175 psig.
 - c. Body Material: Brass or bronze.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Globe Valves:
- 1. Description:
 - a. UL 258 or FM 1140 listed.
 - b. Pressure Rating: 175 psig.
 - c. Body Material: Bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc Holder and Nut: Bronze.
 - g. Disc Seat: Nitrile.
 - h. Packing: Asbestos free.
 - i. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Confirm valve interior to be free of foreign matter and corrosion.
- B. Remove packing materials.
- C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- D. Examine valve threads and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage.
 - 1. Check bolting for proper size, length, and material.
 - 2. Verify gasket for size, defects, damage, and suitable material composition for service.
- F. Replace defective valves with new valves.

3.02 INSTALLATION

- A. Install valves in accessible locations to allow for operation, inspections, tests, and maintenance.
- B. Install listed valves in accordance with their listing.
- C. Install valves in accordance with manufacturer's instructions.
- D. Support valves independently of adjacent piping.
- E. Install valves in horizontal piping with stem at or above pipe center.

- F. Position valves to allow full actuator movement.
- G. Install OS&Y valves with full clearance for rising stem. Install surrounding components so they do not interfere with nor are they impacted by full extension of rising stem.
- H. Install supervised shutoff valves in supervised-open or closed position per application.
- I. Install permanent identification signs per NFPA indicating portion of system controlled by each shutoff valve.
- J. Install threaded-end valves with unions upstream and downstream.
- K. Provide access panel where valve is installed above a hard ceiling. Access panel shall be fire rated in fire rated ceiling assemblies.
- L. Install valve tags. See Section 21 05 53. Label valves in accordance with NFPA standard applying to the piping system in which valves are installed.

3.03 CLOSEOUT ACTIVITIES

- A. Refer to Division 01 for project record documents, operation and maintenance (O&M) data, warranties and bonds.

END OF SECTION

SECTION 21 05 53
IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

- A. Refer to Division 01 for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for fire suppression identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- F. Project Record Documents: Record actual locations of tagged valves.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Major Control Components: Nameplates.
- B. Piping: Tags.
- C. Valves: Tags and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic, multilayer, multicolor, plastic labels for mechanical engraved letters, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 1. Letter Color: White.
 - 2. Background Color: Black.
 - 3. Thickness: 1/8 inch.
 - 4. Plastic: Comply with ASTM D709.

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-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or screws.

2.03 TAGS

- A. Valve Tags: 1-1/2" diameter minimum, stamped or engraved with 1/4 inch letters for piping-system abbreviation and 1/2 inch numbers.
 1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
 2. Fasteners: Brass or stainless steel beaded chain or S-hook.
 3. Valve-Tag Color: Red.
 4. Letter Color: White.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11 inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

2.04 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: brass grommet and brass or stainless steel wire.
 3. Nomenclature: Large-size primary caption such as "DANGER", "CAUTION", or "DO NOT OPERATE"
 4. Color: Yellow background with black lettering.

2.05 PIPE MARKERS

- A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating identification of system type and fluid being conveyed.
- B. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

2.06 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.

PART 3 EXECUTION

3.01 INSTALLATION

- 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 or permanently fasten labels on each piece of equipment.
- D. Install tags with corrosion resistant chain.
- E. Locate labels where accessible and visible.

- F. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- H. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- I. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finish spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection excluding short take-offs. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations 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.

3.02 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping system. List tagged valves in a valve-tag schedule.
- B. Valve-tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-tag Size and Shape" Subparagraph below:
 - 1. Valve-tag Size and Shape:
 - a. Wet-Pipe Sprinkler System: 1-1/2 inches, round.

3.03 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.04 CLOSEOUT ACTIVITIES

- A. Refer to Division 01 for project record documents, operation and maintenance (O&M) data, warranties and bonds.

END OF SECTION

**SECTION 21 07 19
FIRE SUPPRESSION PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07, Firestopping.

1.03 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- D. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

- A. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 650 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm inch.
- C. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.03 CELLULAR GLASS

- A. Pipe and Tube Insulation: ASTM C552, Type II, Grade 6.
 - 1. K Value: 0.35 at 100 degrees F.
 - 2. Service Temperature Range: From minus 450 degrees F to 800 degrees F.
 - 3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
 - 4. Water Absorption: 0.5 percent by volume, maximum.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M, Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.05 JACKETING AND ACCESSORIES

- A. PVC Plastic.
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.
 - 2. Covering Adhesive Mastic: Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Division 07, Firestopping.
- D. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- E. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

END OF SECTION

**SECTION 21 13 00
FIRE-SUPPRESSION SPRINKLER SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Fire department connections.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B31.9 - Building Services Piping; 2025.
- C. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2022.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- E. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- F. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe; 2000.
- G. AWWA C606 - Grooved and Shouldered Joints; 2022.
- H. FM (AG) - FM Approval Guide; Current Edition.
- I. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- J. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- K. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- M. UL (DIR) - Online Certifications Directory; Current Edition.
- N. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems; Current Edition, Including All Revisions.
- O. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.
- P. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

1.04 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. Design: For sprinkler systems indicated to comply with performance requirements and design criteria, including drawings and hydraulic calculations signed and sealed by NICET Level 3 qualified professional who is responsible for their preparation.

1. The design professional shall obtain current water flow test (within 12 months of design submittal) indicating available flow and pressures from existing city water supply.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 1. Margin of Safety for Available Water Flow and Pressure: Shall be a minimum of 10 percent or as required by state and local AHJ, including losses through water-service piping, valves, and backflow preventers, whichever requirement is more stringent.
 2. Sprinkler Occupancy Hazard Classifications: As indicated within the contract drawings.
 3. Minimum Density for Automatic-Sprinkler Piping Design: All areas requiring fire sprinkler protection shall be designed to minimum requirements set forth in NFPA, as indicated within the contract drawings or per state and local AHJ, whichever is more stringent.

1.05 SUBMITTALS

- A. Refer to Division 01 for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, hangers, pipe, fittings and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 1. Include hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, details components, and accessories. Indicate system controls. Indicate all required elements as outlined by NFPA-13 "Shop Drawings"
 2. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Engineer/Architect.
 3. Submit shop drawings, hydraulic calculations and product data to engineer for approval.
- D. Grooved joint couplings and fittings shall be shown on shop drawings and product submittals and shall be specifically identified with the applicable manufacturer, style and model number.
- E. Sprinkler heads shall be referred to on drawings, submittal and other documentation, by the sprinkler identification number (SIN) and model number as specifically published in the appropriate agency listing or approvals. Trade names or other abbreviated designations shall not be allowed.
- F. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer or designer responsible for their preparation.
- G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- H. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- I. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service vendor.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. Refer to Division 01 for additional provisions.
 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
 3. Sprinkler Wrenches: For each sprinkler type.
- K. Qualification data: For qualified installer and NICET Level 3 certificate holder.
- L. Welding certificates.

- M. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.06 COORDINATION

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. Items penetrating finished ceiling include, but not limited to the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Fire alarm speakers

1.07 EXTRA MATERIALS

- A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- B. Furnish extra materials that match products installed and that are packaged with protective coverings for storage and identified with I
 - 1. Refer to Division 01 for additional provisions.
 - 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
 - 3. Sprinkler Wrenches: For each sprinkler type.
 - 4. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA-13 and sprinkler wrenches. Provide larger or additional cabinets when sprinkler head quantities dictate.

1.08 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing NICET Level 3 minimum design services needed to assume design responsibility.
 - a. Designer Responsibility: Preparation of working plans (shop drawings), calculations, and field test reports by a qualified NICET Level 3 professional.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience and approved by manufacturer.
- D. Equipment and Components: Provide products that bear UL (DIR) label or marking.
- E. Products, Components, Devices and Accessories Requiring Electrical Connection: Listed and classified by UL (DIR) and NFPA-70 as suitable for the purpose specified and indicated.
- F. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation and testing shall be in compliance with the standards listed within the contract drawings.
- G. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure vessel Code.
- H. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be of the same manufacturer or compatible with the grooved components supplied.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
 - 1. Manufacturer and model as noted within the contract drawings.

2.02 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for entire building, or as indicated within the contract drawings.
- B. Occupancy: Shall comply with NFPA and as indicated within the contract drawings, most stringent shall be utilized.
- C. Water Supply: Determine volume and pressure from water flow test data.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections where indicated.
- F. Storage Cabinet for Spare Sprinklers and Tools: Steel, locate adjacent to system riser.
- G. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Other Types: As required.
 - 4. Hangers shall be installed per NFPA, manufacturers listing and requirements, coordinated with structure and structural engineer.

2.03 SPRINKLERS

- A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Automatic Sprinklers: 175 psig Minimum.
 - 3. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.
- B. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Nonresidential Applications: UL 199.
 - 2. Characteristics: Nominal orifice with Discharge Coefficient for "Ordinary" temperature classification rating unless otherwise indicated, required by application or NFPA.
- C. Sprinkler Finishes:
 - 1. Provide as indicated within the contract drawings.
- D. Special Coatings:
 - 1. Provide as indicated within the contract drawings.
 - a. Wax.
 - b. Lead.
 - c. Corrosion-resistant paint.
- E. Sprinkler Escutcheons: Materials, types, and finishes shall be as indicated within the contract drawings.
 - 1. Concealed heads shall utilize flat plates.
- F. Sprinkler Guards:
 - 1. Provide where shown on the contract drawings.
 - 2. Standard: UL 199.
 - 3. Type: Wire cage with fastening device for attaching to sprinkler.
 - 4. Head guard shall be listed to be used with installed sprinkler head.
- G. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.

1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- H. Exposed Area Type: Upright type with guard.
1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- I. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- J. Dry Sprinklers: Concealed pendant type with matching push on escutcheon plate.
1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- K. Guards: Finish to match sprinkler finish.
- L. Flexible Drop System: Stainless steel, multiple use, open gate type.
1. Application: Use to properly locate sprinkler heads.
 2. Include all supports and bracing.
 3. Provide braided type tube as required for the application.
 4. 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. FlexHead Industries, a brand of Anvil International; _____:
www.anvilintl.com/#sle.
 - b. Victaulic Company; Vic-Flex: www.victaulic.com/#sle.

2.04 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
1. Activate electric alarm.
 2. Test and drain valve.
 3. Replaceable internal components without removing valve from installed position.
- B. Test Connections:
1. Inspector's Test Connection for Preaction Systems:
 - a. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
 - b. Supply discharge orifice with same size as corresponding sprinkler orifice.
 - c. Limit vertical height of exterior wall penetration to 2 ft above finished grade.
 2. Backflow Preventer Test Connection:
 - a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch National Standard male hose threads with cap and chain.
 - b. Furnish one valve for each 250 gpm of system demand or fraction thereof.
 - c. Provide permanent sign reading "Test Valve" in accordance with Section 21 05 53.
- C. Fire Department Connections:
1. Type: Exposed, projected wall mount made of corrosion resistant metal complying with UL 405.

- a. Inlets: Two way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
- b. Outlet: Back with pipe threads, 4 NPS.
- c. Rated Working Pressure: 175 psi.
- d. Finish: Polished brass.
- e. Signage: Raised or engraved lettering 1 inch minimum indicating system type.

2.05 ALARM DEVICES

- A. Electrically Operated Alarm Bell:
 - 1. Standard: UL 464.
 - 2. Type: Vibrating, metal alarm bell.
 - 3. Size: 6-inch (150-mm) minimum- diameter.
 - 4. Finish: Red-enamel factory finish, suitable for outdoor use.
- B. Water-Flow Indicators:
 - 1. Standard: UL 346.
 - 2. Water-Flow Detector: Electrically supervised.
 - 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 4. Type: Paddle operated.
 - 5. Pressure Rating: 250 psig.
 - 6. Design Installation: Horizontal or vertical.
- C. Pressure Switches:
 - 1. Standard: UL 346.
 - 2. Type: Electrically supervised water-flow switch with retard feature.
 - 3. Components: Single-pole, double-throw switch with normally closed contacts.
 - 4. Design Operation: Rising pressure signals water flow.
- D. Valve Supervisory Switches:
 - 1. Standard: UL 346.
 - 2. Type: Electrically supervised.
 - 3. Components: Single-pole, double-throw switch with normally closed contacts.
 - 4. Design: Signals that controlled valve is in other than fully open position.

PART 3 EXECUTION

3.01 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA-13 and NFPA-291. Use results for required system design calculations.
- B. Official documentation witnessed by local AHJ shall be provided with shop drawing submittal.

3.02 SERVICE ENTRANCE PIPING

- A. Aboveground piping shall only be connected upon completion of flushing and testing of the underground piping system.
- B. Official completed, witnessed and signed test certificates shall be provided before connection between aboveground and underground piping is performed.

3.03 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.3

- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect/Engineer before deviating from approved working plans.
- C. Install equipment in accordance with manufacturer's instructions.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle. Clearance shall be in accordance with local fire department requirements.
- E. Install wall-type, fire-department connections.
- F. Install automatic (ball drip) drain valve at each check valve for fire-department connection.
- G. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- H. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- J. Locate outside alarm gong on building wall as indicated.
- K. Place pipe runs to minimize obstruction to other work.
- L. Place piping in concealed spaces above finished ceilings.
- M. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- N. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- O. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- P. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- Q. 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.
- R. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- S. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- T. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- U. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

- V. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Section 210553 - Identification for Fire Suppression Piping and Equipment.
- W. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- X. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- Y. Flush entire piping system of foreign matter.
- Z. Hydrostatically test entire system.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.05 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.
- B. Coordinate all electrical requirements with electrical contractor based on equipment or product being provided and installed.

3.06 CLOSEOUT ACTIVITIES

- A. Refer to Division 01: project record documents, operation and maintenance (O&M) data, warranties and bonds.
- B. Provide service and maintenance of equipment installed under this section for one year from the date of substantial completion.

END OF SECTION

SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

- 1.01 SECTION INCLUDES
 - A. Pipe sleeves.
 - B. Pipe sleeve-seals.
- 1.02 RELATED REQUIREMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- 1.03 REFERENCE STANDARDS
 - A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
 - B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
 - C. FM (AG) - FM Approval Guide; Current Edition.
 - D. UL (DIR) - Online Certifications Directory; Current Edition.
- 1.04 SUBMITTALS
 - A. See Division 01 for submittal procedures.
- 1.05 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
 - B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.
- 1.06 WARRANTY
 - A. Correct defective Work within a five year period after Date of Substantial Completion.
 - B. Refer to Division 01 for additional warranty requirements.

PART 2 PRODUCTS

- 2.01 PIPE SLEEVES
 - A. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
 - B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
 - C. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
 - D. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.

2. Connect sleeve with floor plate except in mechanical rooms.
- E. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Engineer/Architect.
- G. Clearances:
 1. Provide allowance for insulated piping.
 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Modular Mechanical Sleeve-Seal:
 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 3. Size and select seal component materials in accordance with service requirements.
 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. Fire Resistant: 1 hour, UL (DIR) approved.
 - e. High Temperature, up to 400 degrees F.
 - f. Low temperature, down to minus 67 degrees F.
 5. Glass-reinforced plastic pressure end plates.
- B. Sealing Compounds:
 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.
- C. Pipe Sleeve Material:
 1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
 2. Masonry Structures: Sheet metal or fiber.
- D. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.
- E. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch thick.
- F. Pipeline-Casing Seals:
 1. Coated boltless casing-spacer for 4 inch carrier pipe.
 2. Coated boltless modular seal for 6 inch carrier pipe.
 3. Carbon steel band with risers for 12 inch carrier pipe.
 4. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface. Otherwise extend sleeves in mechanical equipment rooms or other wet areas 2 inches above finished floor.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations: Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 - 2. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 - 3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.
 - 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a water-tight seal.
 - 6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

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

END OF SECTION

SECTION 22 05 19
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges.
- B. Thermometers.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters; 2022.
- E. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- F. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Bourdon Tube for Liquids and Gases:
 - 1. Dial Size and Cover: 4-1/2 inch diameter scale with polycarbonate window.
 - 2. Dial Text and Markings: Black color on white background with scaled psi units.
 - 3. Accuracy: ASME B40.100, adjustable commercial grade (B) with 2 percent at mid-range of span.
 - 4. Process Connection: Bottom, 1/4 inch NPT male except where noted.
 - 5. Gauge Wetted Materials: Painted steel case and brass socket rated to match process pressure and temperature range.
 - 6. Comply with UL 393 when used for fire protection service or UL 404 when used for compressed gas service.

2.02 THERMOMETERS

- A. General:
 - 1. Product Compliance: ASTM E1.
 - 2. Lens: Clear glass, except where stated.
 - 3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
 - 4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.

- B. Thermometers - Adjustable Angle: 7 inch v-shape aluminum case with clear glass window scale, 6 inch NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install pressure gauges as follows:
 - 1. At Pumps: Place single gauge at suction side and discharge side.
 - 2. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.
- B. Install thermometers as follows:
 - 1. Water Heaters: Place upstream and downstream of heater.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

1.03 ABBREVIATIONS AND ACRONYMS

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

1.04 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- C. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.
- F. ASME B31.9 - Building Services Piping; 2025.
- G. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.
- H. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- I. MSS SP-45 - Drain and Bypass Connections; 2020.
- J. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- K. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- L. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- M. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
 - 1. Handle large valves with sling, modified to avoid damage to exposed parts.
 - 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball.
 - 2. Throttling: Ball.
 - 3. Swing Check:
 - a. 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Domestic, Hot and Cold Water Valves:
 - 1. 2 inch and Smaller:

- a. Bronze and Brass: Provide with solder-joint, threaded, or press ends.
- b. Ball: Two piece, full port, brass or bronze with brass trim.
- c. Bronze Swing Check: Class 125, bronze disc.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Hand Lever: Quarter-turn valves 6 inch and smaller.
- D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
 - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Solder Joint Connections: ASME B16.18.
- F. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Solder-joint Connections: ASME B16.18.
 - 3. Building Services Piping Valves: ASME B31.9.
- G. Potable Water Use:
 - 1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 - 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Valve Bypass and Drain Connections: MSS SP-45.

2.03 BRASS, BALL VALVES

- A. Two Piece, Full Port with Brass Trim and Female Thread, Male thread, or Solder Connections:
 - 1. Comply with MSS SP-110.
 - 2. WOG Rating: 600 psi.
 - 3. Body: Forged brass, low lead compliant.
 - 4. Seats: PTFE.
 - 5. Stem: Brass.
 - 6. Ball: Chrome-plated brass.
 - 7. Operator: Lockable handle and memory stop.
- B. Two Piece, Full Port with Press Connections:
 - 1. WOG Rating: 250 psi.
 - 2. Body: Forged brass.
 - 3. Seats: PTFE.
 - 4. Ball: Chrome-plated brass.
 - 5. Stem: Forged brass.
 - 6. Operator: Provide lockable handle and memory stop.
 - 7. Maximum Service Temperature: 250 degrees F.

2.04 BRONZE, BALL VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.

2. Copper alloys containing more than 15 percent zinc are not permitted.
 - B. Two Piece, Full Port with Bronze Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. CWP or WOG Rating: 250 psi.
 4. Body: Forged bronze or dezincified-brass alloy.
 5. End Connections: Pipe press, thread, or solder.
 6. Seats: PTFE.
 7. Stem: Bronze, blowout proof.
 8. Ball: Chrome plated brass.
 9. Operator: Provide lockable handle and memory stop.
- 2.05 BRASS, HORIZONTAL SWING CHECK VALVES
- A. Class 125, Threaded or Soldered End Connections:
 1. CWP or WOG Rating: 200 psi.
 2. Body: Forged brass.
 3. Disc: Forged brass.
 4. Hinge-Pin, Screw, and Cap: Forged brass.
 - B. Class 125, Press End Connections:
 1. CWP or WOG Rating: 200 psi.
 2. Body: Forged brass.
 3. Disc: Forged brass.
 4. Hinge-Pin, Screw, and Cap: Forged brass.

2.06 BRONZE, SWING CHECK VALVES

- A. General:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. WOG Rating: 200 psi.
 4. Body: Bronze, ASTM B62.
 5. End Connections: Threaded.
 6. Disc: Bronze.
- C. Class 150:
 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. WSP Rating: 150 psi.
 4. WOG Rating: 300 psi.
 5. Body: Bronze, ASTM B62.
 6. End Connections: Threaded or soldered.
 7. Disc: Bronze.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.

- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

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

2.02 NAMEPLATES

- A. Description: Laminated piece with up to three lines of text.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/2 inch.
 - 3. Background Color: Black.
 - 4. Nameplate Height: 1 inch.
 - 5. Nameplate Material:
 - a. Flexible: Vinyl with adhesive backing per ASTM D709.
 - b. Metal: Brass with center-side holes for screw fastening.

2.03 TAGS

- A. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch in diameter.
- B. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
- C. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.

- D. Piping: 3/4 inch diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

2.04 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- C. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- D. Identification Scheme, ASME A13.1:
 - 1. Primary: External Pipe Diameter, Uninsulated or Insulated.
 - a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
 - b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
 - c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

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

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).
- E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- G. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- I. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- L. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section <>.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER INSULATION

- A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 650 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- G. Fibrous Glass Fabric:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Blanket: 1.0 pcf density.
 - 3. Weave: 5 by 5.
- H. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
- I. Insulating Cement: ASTM C449.

2.03 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
 - 2. Covering Adhesive Mastic: Compatible with insulation.

- B. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch sheet.
 - 3. Finish: Smooth.
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 - 6. Metal Jacket Bands: 1/2 inch wide; 0.020 inch thick aluminum.
- C. Aluminum-Foil Laminate Jacket:
 - 1. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
 - 2. Finish: Aluminum smooth.
 - 3. Comply with ASTM C1775.
- D. Reinforced Tape:
 - 1. All Service Jacket tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 - 2. Comply with UL 723 or ASTM E84.
 - 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- D. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- G. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.

4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Division 07, Fire Stopping.

3.03 SCHEDULES

- A. Plumbing Systems:
1. Domestic Hot Water Supply and Recirculation:
 - a. Glass Fiber Insulation - Runouts:
 - 1) Pipe Size Range: 1-1/4" and Smaller.
 - 2) Thickness: 1".
 - 3) Pipe Size Range: 1-1/2" and Larger.
 - 4) Thickness: 1-1/2".
 2. Domestic Cold Water:
 - a. Pipe Size Range: All sizes.
 - b. Thickness: 1".
 3. Roof Drain Bodies:
 4. Roof Drainage Run Horizontal at Roof Level:

END OF SECTION

**SECTION 22 10 05
PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary waste piping, buried within 5 feet of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet of building.
- D. Domestic water piping, above grade.
- E. Pipe flanges, unions, and couplings.
- F. Pipe hangers and supports.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ANSI LC 4/CSA 6.32 - Press-Connect Metallic Fittings and Valves for Use in Fuel Gas Distribution Systems; 2022.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- D. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings; 2021.
- E. ASTM B32 - Standard Specification for Solder Metal; 2020.
- F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- H. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2024.
- I. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- J. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- K. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- L. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- M. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).
- N. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2024.
- O. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).
- P. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2024, with Editorial Revision (2025).

- Q. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).
 - R. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2025.
 - S. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2025.
 - T. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2024.
 - U. AWWA C651 - Disinfecting Water Mains; 2023.
 - V. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
 - W. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
 - X. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential; 1989.
 - Y. IAPMO (UMC) - 2024 Uniform Mechanical Code; 2024.
 - Z. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - AA. IAPMO/ANSI/CAN Z1117 - Standard for Press Connections; 2022.
 - BB. ICC (IFGC) - International Fuel Gas Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - CC. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - DD. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
 - EE. ICC-ES AC106 - Acceptance Criteria for Pre drilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
 - FF. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
 - GG. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
 - HH. NSF 61 - Drinking Water System Components - Health Effects; 2024.
 - II. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- 1.04 SUBMITTALS
- A. See Division 01 for submittal procedures.
 - B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- 1.05 QUALITY ASSURANCE
- A. Perform work in accordance with applicable codes.
 - B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- B. PVC Pipe: ASTM D2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY WASTE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. PVC Pipe: ASTM D2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
 - 3. Mechanical Press Sealed Fittings: ASME B16.51 or IAPMO/ANSI/CAN Z1117, ICC (IPC), and IAPMO (UPC) approved, NSF 61 and NSF 372 certified, with EPDM seals.
- B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876.
 - 1. Fittings: Brass.
 - 2. Joints: ASTM F1960 cold-expansion fittings.
 - 3. Joints: ASTM F1807 metal insert fittings with copper crimp ring or stainless steel clamps.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
 - 3. Mechanical Press Sealed Fittings: ASME B16.51 or IAPMO/ANSI/CAN Z1117, ICC (IPC), and IAPMO (UPC) approved, NSF 61 and NSF 372 certified, with EPDM seals.
- B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
 - 1. Fittings: BrassASTM F1960.

2. Joints: ASTM F1960 cold-expansion fittings.
3. Joints: ASTM F1807 metal insert fittings with copper crimp ring or stainless steel clamps.

2.06 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch and Under:
 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. No-Hub Couplings:
 1. Testing: In accordance with ASTM C1277 and CISPI 310.
 2. Gasket Material: Neoprene complying with ASTM C564.
 3. Band Material: Stainless steel.
 4. Eyelet Material: Stainless steel.
- C. Shielded, Heavy Duty No-Hub Couplings:
 1. Testing: In accordance with ASTM C1540 and FM 1680.
 2. Gasket Material: Neoprene complying with ASTM C564.
 3. Band Material: Stainless steel.
 4. Eyelet Material: Stainless steel.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.07 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
- B. Plumbing Piping - Drain, Waste, and Vent:
 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 2. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
 3. Wall Support for Pipe Sizes to 3 inch: Cast iron hook.
 4. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water:
 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 2. Hangers for Cold Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 to 4 inch: Carbon steel, adjustable, clevis.
 4. Wall Support for Pipe Sizes Up to 3 inch: Cast iron hook.
 5. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 6. Floor Support for Hot Pipe Sizes to 4 inch: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
 7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 1. Concrete Wedge Expansion Anchors: Comply with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Comply with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Comply with ICC-ES AC193.

4. Masonry Screw Type Anchors: Comply with ICC-ES AC106.
5. Other Types: As required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed.
 1. Coordinate size and location of access doors per appropriate Division 08 section.
- H. Establish elevations of buried piping outside the building to ensure piping is installed at least 6" below the region's frost line, and not less than 1'-0" below grade.
- I. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
- J. Excavate, trench, and backfill in accordance with local codes and civil and structural engineer's documents. Coordinate excavation, trenching, and backfill with other trades.
- K. Install valves with stems upright or horizontal, not inverted.
- L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- M. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- N. Sleeve pipes passing through partitions, walls, and floors.
- O. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- P. Pipe Hangers and Supports:
 1. Install in accordance with MSS SP-58 and local codes.
 2. Support horizontal piping as indicated.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 4. Place hangers within 12 inches of each horizontal elbow.
 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 8. Provide copper plated hangers and supports for copper piping for uninsulated copper piping.
 9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - a. Painting of interior plumbing systems and components is specified in Division 09.
 10. Support cast iron drainage piping at every joint.
- Q. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.04 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball valves for throttling, bypass, or manual flow control services.
- E. Provide spring-loaded check valves on discharge of water pumps.
- F. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated. Slope to drain at minimum of 1/4 inch per foot slope for drainage piping smaller than 3" and 1/8 inch per foot for piping 3" and larger. For drainage piping upstream of a grease interceptor, slope all piping to drain at a minimum of 1/4 inch per foot.

3.06 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
 1. Perform hydrostatic testing for leakage prior to system disinfection.
 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
 3. General:
 - a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.
- C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.

- B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

- A. Connect to existing sanitary sewer service as shown. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Connect to existing domestic water service as shown. Verify existing backflow preventer and pressure reducing valve are in good working order.
 - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2. Provide 18 gauge, 0.0478-inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.09 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1. Metal Piping:
 - a. Pipe Size: 1/2 inch to 1-1/4 inch:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inch to 2 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe Size: 2-1/2 inch to 3 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.
 - d. Pipe Size: 4 inch to 6 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 5/8 inch.
 - e. Pipe Size: 8 inch to 12 inch:
 - 1) Maximum hanger spacing: 14 ft.
 - 2) Hanger Rod Diameter: 7/8 inch.
 - f. Pipe Size: 14 inch and Over:
 - 1) Maximum Hanger Spacing: 20 ft.
 - 2) Hanger Rod Diameter: 1 inch.
 - 2. Plastic Piping:
 - a. All Sizes:
 - 1) Maximum Hanger Spacing: 6 ft.

- 2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION

SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mixing valves.
- B. Balancing valves.
- C. Outlet boxes.
- D. Hose bibbs.
- E. Hydrants.
- F. Drain valves.
- G. Water-hammer arrestors.

1.02 RELATED REQUIREMENTS

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

1.03 ABBREVIATIONS AND ACRONYMS

- A. DZR: Dezincification resistant.

1.04 REFERENCE STANDARDS

- A. ASSE 1010 - Performance Requirements for Water Hammer Arresters; 2021.
- B. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
- C. ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems; 2023.
- D. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.
- E. ASSE 1052 - Performance Requirements for Hose Connection Backflow Preventers; 2023.
- F. ASSE 1053 - Performance Requirements for Dual Check Backflow Preventer Wall Hydrants - Freeze Resistant Type; 2019 (Reaffirmed 2023).
- G. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- H. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- I. PDI-WH 201 - Water Hammer Arresters; 2017.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.
- C. Operation and Maintenance Data: Provide for products listed below.
- D. Specimen warranty: Submit sample of manufacturer's warranty.
- E. Executed warranty.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Division 01 for packaging waste requirements.

- B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- C. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- D. Store products under cover and protected from weather and dirt. Elevate above grade.
- E. Protect end connections, flanges, threads, and grooves from dirt and damage.
- F. Protect product interiors against rust and corrosion.
- G. Do not use operating handles or stems as lifting or rigging points.

1.07 WARRANTY

- A. See Division 01, Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products complying with NSF 61 and NSF 372.
- B. Source Limitations: Furnish domestic water piping specialties of same kind by same manufacturer.
- C. Provide brass-bodied domestic water piping specialties in DZR brass.

2.02 MIXING VALVES

- A. Thermostatic Master Mixing Valves:
 - 1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 - 2. Valve: ASSE 1017, brass or bronze body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment.
 - 3. Accessories:
 - a. Strainer stop checks on inlets.
 - b. Shut-off valve on inlets and outlet.
 - c. Stem thermometer on outlet.

2.03 BALANCING VALVES

- A. Thermostatic Balancing Valves:
 - 1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 - 2. Valve: Brass, with thermostatic element to maintain constant temperature in domestic hot water recirculating system; provide with tamper-resistant temperature adjustment knob.
 - 3. Accessories:
 - a. Check valve.
 - b. Manufacturer's insulation shell.
 - c. Temperature gauge.
 - 4. Maximum Working Pressure: 150 psi.
 - 5. Working Temperature Range: 33 to 200 degrees F.

2.04 OUTLET BOXES

- A. Ice Maker Outlet Boxes:
 - 1. Manufacturers:
 - a. Reference drawings for specifying schedules.

2. Description: Plastic preformed square or round rough-in box with quarter-turn ball valve and slip-in finishing cover.
3. Provide fire-rated outlet-box assembly for installation in 1- and 2-hour-rated walls.
4. Accessories:
 - a. Water-hammer arrestors.
 - b. Support brackets for installation between framing studs.

2.05 HOSE BIBBS

- A. Manufacturers:
 - a. Reference drawings for specifying schedules.
- B.
- C. Hose Bibbs:
 1. Valve: Bronze or brass body with mounting flange, replaceable seat, hose thread spout, and integral or add-on vacuum breaker complying with ASSE 1011.
 2. Maximum Working Pressure: 125 psi.
 3. Working Temperature Range: 33 to 120 degrees F.

2.06 HYDRANTS

- A. Wall Hydrants:
 - a. Reference drawings for specifying schedules.
 1. Assembly: ASSE 1011, ASSE 1019, ASSE 1052, or ASSE 1053.
 2. Hydrant: Freeze-resistant, self-draining, wall-mounted.
 - a. Valve: Bronze or brass body.
 - b. Hose Connection: Threaded, with integral vacuum breaker or backflow preventer.
 3. Maximum Working Pressure: 125 psi.
 4. Working Temperature Range: 33 to 120 degrees F.

2.07 DRAIN VALVES

- A. Ball-Valve Hose-End Drain Valves:
 1. Valve: Two-piece, full-port ball valve in brass or bronze with capped hose-end connection.
 2. Pressure Rating: 250 psi.
 3. Working Temperature Range: 33 to 140 degrees F.

2.08 WATER-HAMMER ARRESTORS

- A. Manufacturers:
 - a. Reference drawings for specifying schedules.
- B. Piston Type:
 1. Description: ASSE 1010 or PDI-WH 201, copper body with plastic piston and EPDM O-rings.
 2. Air Preload Pressure: 60 psi.
 3. Maximum Working Pressure: 150 psi.
 4. Working Temperature Range: 33 to 180 degrees F.
- C. Bellows Type:
 1. Description: ASSE 1010 or PDI-WH 201, stainless steel body with stainless steel bellows.
 2. Maximum Working Pressure: 150 psi.
 3. Working Temperature Range: 33 to 180 degrees F.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard packing materials and verify product interiors are free from debris, damage, and corrosion.
- B. Verify end connections, flanges, threads, and grooves are completely clean without signs of damage or degradation that could result in leakage.
- C. For products containing isolation or shutoff valves, verify isolation and shutoff valves operate smoothly from fully closed to fully open.

3.02 INSTALLATION

- A. Prior to installation of domestic water piping specialties, flush domestic water piping of foreign material.
- B. Install products in accordance with manufacturer's instructions.
- C. Install products level and plumb.
- D. Install products with clearance for access and maintenance.
- E. For products containing isolation or shutoff valves, locate valves in horizontal piping with stems at or above center of piping, maintaining unimpeded stem movement.
- F. Thermostatic Master Mixing Valves: Unless noted otherwise on drawings, install with centerline at 48 inches above finish floor.
- G. Balancing Valves: Install in accessible locations. Install shutoff valves on inlet and outlet.
- H. Water Hammer Arrestors: Install in accordance with PDI-WH 201.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Inspect each product for damage and defects.
- C. Repair or replace damaged products.
- D. Replace defective products.
- E. For products containing isolation or shutoff valves, exercise isolation and shutoff valves from fully closed to fully open. Confirm smooth operation.
- F. Mixing Valves: Confirm outlet temperature remains steady without fluctuation.
- G. Coordination of Other Tests and Inspections: Provide access to accommodate tests and inspections by independent testing agencies employed by Owner.

3.04 ADJUSTING

- A. Adjust mixing valves to design temperature set point.
- B. Adjust thermostatic balancing valves to design temperature setpoint.

3.05 CLEANING

- A. See Division 01 for additional requirements.
- B. Clean products to remove dirt, paint, and other foreign materials.
- C. Clean surfaces of products exposed to view in finished spaces to remove dirt, fingerprints, paint, and other foreign materials. Restore finishes to match original factory finish.
- D. Clean surfaces of products exposed to view on building exterior to remove dirt, fingerprints, paint, and other foreign materials. Restore finishes to match original factory finish.
- E. Remove debris and clean interiors of equipment cabinets.
- F. Clean strainers, including those internal to other products, prior to project substantial completion.

3.06 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.

END OF SECTION

**SECTION 22 11 23
DOMESTIC WATER PUMPS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Circulators.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NSF 61 - Drinking Water System Components - Health Effects; 2024.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Provide certified pump curve with duty point marked over pump and system operating conditions.
 - 2. Manufacturer's catalog sheets for fixtures, fittings, accessories, and supplies.
- B. Shop Drawings: Include dimensions and performance data.
- C. Project Record Documents: Record actual locations of components.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY

- A. Manufacturer Warranty: Provide 5-year manufacturer warranty for circulators. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 CIRCULATORS

- A. Manufacturers:
 - a. Reference drawings for specifying schedules.
- B. Casing: Stainless steel body with stainless steel cast or plastic impeller; wet rotor type.
- C. Shaft: Ceramic or stainless steel.
- D. Pipe-End Connection: Union connection.
- E. Maximum Working Pressure: 145 psi.
- F. Motor: ECM permanent magnet.

- G. Service Temperature Range: 14 to 230 degrees F.
- H. Controls: Provide aquastat set for high-temp cutoff, hand switch, and time clock set for business hours.
- I. Accessories: Include inlet-outlet temperature and pressure gauges with 2-way isolation valves.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products with related fittings, and accessories according to manufacturer instructions.
- B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).
- C. Electrical-Driven Pump Work:
 - 1. Provide electric-motor-driven equipment specified complete with local disconnect switch and control panel with starter, controls, safety devices, and related wiring.
 - 2. Provide automatic control and protective devices field-wired to interface-related devices required for specified operation.
- D. Ensure that small pressure gauges are installed on both upstream and downstream ends.
- E. Hot Water Service: Ensure that small pressure-temperature gauges are installed on both upstream and downstream ends.
- F. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are nonoverloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3.02 FIELD QUALITY CONTROL

- A. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.03 CLEANING

- A. Thoroughly clean plumbing fixtures and equipment.

3.04 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION

SECTION 22 13 19
SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Floor drains.
- B. Floor sinks.
- C. Cleanouts.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor Drains; 2022.
- C. ASME A112.6.7 - Sanitary Floor Sinks; 2022.
- D. ASME A112.36.2 - Cleanouts; 2022.
- E. ASSE 1072 - Performance Requirements for Barrier Type Trap Seal Protection for Floor Drains; 2020.
- F. NSF 14 - Plastics Piping System Components and Related Materials; 2023.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on fabrication materials, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Store products under cover and protected from weather and dirt. Elevate above grade.
- D. Store plastic products protected from direct sunlight.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Plastic Sanitary Waste Piping Specialties: Provide plastic products that comply with NSF 14.
- B. Source Limitations: Furnish drains and sanitary waste piping specialties of same kind by same manufacturer.

2.02 FLOOR DRAINS

- A. Cast Iron Floor Drains:
 - 1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 - 2. Assembly: ASME A112.6.3.
 - 3. Body: Lacquered cast iron with anchor flange and membrane clamping collar with weepholes.

4. Strainer: Adjustable, removable, with vandal-proof screws.
 - a. Round:
 - 1) Material: Nickel bronze.
 - 2) Diameter: 6 inches.
- B. Cast Iron Area Drains:
 1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 2. Assembly: ASME A112.6.3.
 3. Body: Lacquered cast iron with anchor flange with weepholes and membrane clamping collar.
 4. Grate: Ductile or cast iron, loose set in top frame.
 - a. Round:
 - 1) Diameter: 9 inches.
 - 2) Finish: Factory-lacquered finish.

2.03 FLOOR SINKS

- A. Cast Iron Floor Sinks:
 1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 - b. MIFAB, Inc: www.mifab.com/#sle.
 2. Assembly: ASME A112.6.7.
 3. Body: Cast iron with white acid-resistant enameled interior and interior anti-splash dome strainer.
 - a. Square:
 - 1) Size: 12 by 12 inches.
 - 2) Sump Depth: 6 inches.
 4. Clamping Flange: Provide anchor flange with membrane clamping collar.
 5. Grate: Loose set.
 - a. Style: Half grate.

2.04 CLEANOUTS

- A. Manufacturers:
 1. Reference drawings for specifying schedules.
- B. Floor Cleanouts:
 1. Assembly: ASME A112.36.2.
 2. Body: Lacquered cast iron.
 3. Closure Plug: Bronze, threaded, gastight and watertight.
 4. Top: Adjustable.
 - a. Shape and Finish:
 - 1) All Locations, Unless Noted Otherwise: Round; nickel bronze.
 - 2) Carpet: Install carpet over cleanout; provide carpet marker.
- C. Wall Cleanouts:
 1. Assembly: ASME A112.36.2.
 2. Body: Tee type; body material to match surrounding pipe.
 3. Plug: PVC or ABS, threaded, gastight.
 4. Access Cover: Round, stainless steel wall access cover with vandal-proof screw.

2.05 MISCELLANEOUS SANITARY WASTE PIPING SPECIALTIES

- A. Floor Drain Trap Seals:
 1. Manufacturers:

- a. Reference drawings for specifying schedules.
- 2. Assembly: ASSE 1072.
- 3. Description: Push-fit EPDM or silicone fitting with one-way-flow membrane or flapper.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify conditions are satisfactory for installation prior to starting work.
- B. Verify floor sink locations are coordinated with latest published kitchen equipment plans and plumbing plans.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Maintain continuity of waterproofing membranes. Secure waterproofing membranes to drain clamping collars and bonding flanges.
- C. Install drains so strainers and grates are level and are at design elevation.
- D. Install floor sinks so grates are flush with finished floor unless noted otherwise or unless directed otherwise by adopted code.
- E. Extend cleanouts to finished floor or wall surface. Ensure clearance at cleanout for rodding or jetting of drainage system.
- F. Install floor cleanouts to allow for floor finishes.
- G. Locate, provide, and install cleanouts in piping in accordance with adopted code.

3.03 CLEANING

- A. Clean debris from drains.
- B. Clean grates and strainers prior to substantial completion.

3.04 PROTECTION

- A. Protect installed drains from accumulating dirt and debris through remainder of construction.
- B. Protect installed products from damage due to subsequent construction operations.

END OF SECTION

SECTION 22 13 23
SANITARY WASTE INTERCEPTORS

PART 1 GENERAL

- 1.01 SECTION INCLUDES
 - A. Grease interceptors.
- 1.02 RELATED REQUIREMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- 1.03 REFERENCE STANDARDS
 - A. ASME A112.14.3 - Hydromechanical Grease Interceptors; 2022.
 - B. PDI G101 - Testing and Rating Procedure for Grease Interceptors; 2017.
- 1.04 SUBMITTALS
 - A. See Division 01 for submittal procedures.
 - B. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on fabrication materials, assembly of components, dimensions, capabilities, rated flow rates, retention capacities, rough-in requirements, location and sizes of piping connections, service and access locations, and manufacturer-provided and field-installed accessories.
 - C. Project Record Documents: Indicate installed interceptor assembly, including adjacent sanitary waste and vent piping. Show inlet and outlet inverts for buried or recessed interceptors and for interceptors installed in sub-slab locations
- 1.05 DELIVERY, STORAGE, AND HANDLING
 - A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
 - B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

PART 2 PRODUCTS

- 2.01 GENERAL REQUIREMENTS
 - A. Source Limitations: Furnish interceptors of same kind by same manufacturer.
- 2.02 GREASE INTERCEPTORS
 - A. Hydromechanical Grease Interceptors, 50 gpm and Smaller:
 - 1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 - 2. Assembly: ASME A112.14.3.
 - 3. Body: Thermoplastic polymer.
 - 4. Lid: Gasketed, secured, nonskid, in same material as body of interceptor.
 - 5. Accessories:
 - a. Lid extensions or risers.
 - b. Pump out port.

PART 3 EXECUTION

- 3.01 EXAMINATION

- A. Verify field measurements are as indicated.
- B. Verify rough-ins for field connections match sizes and locations shown on drawings.
- C. Verify field piping connections are at inverts indicated on drawings.
- D. Verify excavation, trenching, and bedding are complete and ready to receive equipment.
- E. Verify conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, adopted code, and requirements of local authorities having jurisdiction.
- B. Install interceptors level and plumb.
- C. Refer to drawings and see Section 22 10 05 for requirements for waste and vent piping to and from interceptors.
- D. Support waste and vent piping independently from interceptors.
- E. Vent interceptors in accordance with adopted code and with requirements of local authorities having jurisdiction.
- F. Install interceptors with clearance for access and maintenance.
- G. Install lid extensions so interceptor lids are level with finished floor.
- H. Backfill buried interceptors in accordance with manufacturer's instructions.

3.03 FIELD QUALITY CONTROL

- A. Test interceptors for leaks in accordance with manufacturer's instructions.

3.04 CLEANING

- A. Clean debris from within interceptors.
- B. Clean lids and manhole covers to remove dirt, debris, and other foreign material.

3.05 PROTECTION

- A. Protect installed interceptors from accumulating dirt and debris through remainder of construction.
- B. Protect installed products from damage due to subsequent construction operations.

END OF SECTION

**SECTION 22 30 00
PLUMBING EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rack-mounted, tankless, gas-fired water heaters.
- B. Commercial gas-fired water heaters.
- C. Commercial indirect-fired water heaters.
- D. Residential electric water heaters.
- E. Tankless electric water heaters.
- F. Commercial electric water heaters.
- G. Commercial gas-fired water boilers.
- H. Packaged water heating systems.
- I. Domestic-water heat exchangers.
- J. Domestic hot water storage tanks.
- K. Water storage tanks - gravity, nonpressurized.
- L. Diaphragm-type compression tanks.
- M. Water filters.
- N. Water softeners.
- O. Acid-effluent neutralizers.
- P. UV sterilizers.
- Q. Reverse osmosis equipment.
- R. Deionization equipment.
- S. Copper-silver ionization equipment.
- T. Point-of-use water filters.
- U. Point-of-entry water filters.
- V. In-line circulator pumps.
- W. Pressure booster systems.
- X. Condensate removal pumps.
- Y. Domestic, storm, and sanitary-sewage pumps.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; 2014 (Reaffirmed 2020).
- C. AHRI 550/590 (I-P) - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle; 2023.
- D. AHRI 575 - Method of Measuring Machinery Sound Within an Equipment Space; 2017.

- E. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- F. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less; 2019 (Reaffirmed 2024).
- G. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous; 2019 (Reaffirmed 2024).
- H. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- I. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Errata (2025).
- J. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2026).
- L. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .
- M. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- N. AWWA C652 - Disinfection of Water-Storage Facilities; 2019.
- O. AWWA D121 - Bolted Aboveground Thermosetting Fiberglass-Reinforced Plastic Panel-Type Tanks for Water Storage; 2024.
- P. Bluetooth CS - Bluetooth Core Specification; 2016, Addendum 2017.
- Q. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- R. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks--Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; 2024, with Amendment (2025).
- S. IEEE 802.15.4 - IEEE Standard for Low-Rate Wireless Networks; 2024.
- T. LonMark Interoperability Guide - LonMark Application-Layer Interoperability Guide and LonMark Layer 1-6 Interoperability Guide; Version 3.4; 2005.
- U. Modbus (PS) - The Modbus Organization Communications Protocol.; Latest Update.
- V. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- W. NFPA 31 - Standard for the Installation of Oil-Burning Equipment; 2024.
- X. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- Y. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- Z. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.
- AA. UL 1081 - Swimming Pool Pumps, Filters, and Chlorinators; Current Edition, Including All Revisions.
- BB. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.
- CC. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Division 01 for submittals procedures.
- B. Product Data:
 - 1. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, weights, capabilities, performance, electrical characteristics, location and sizes of connections, service and access locations, and manufacturer-provided and field-installed accessories.
- C. Shop Drawings:
 - 1. Provide for the following equipment:
 - a. Water heaters.
 - b. Boilers and packaged water heating systems.
 - c. Heat exchangers.
 - d. Water tanks.
 - e. Water filters and purification equipment.
 - f. Water softeners.
 - g. Reverse osmosis equipment.
 - h. Deionization equipment.
 - 2. Provide plans and elevations showing equipment assembly, including fabrication and installation details. Show location and sizes of connections.
 - 3. Indicate clearances required for service, access, maintenance, and replacement of internal components.
- D. Designer's qualification statement.
- E. Manufacturer's qualification statement.
- F. Project Record Documents: Record actual locations of components.
- G. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Design Engineer's Qualifications for Field-Erected Water Tanks: Professional engineer licensed to practice in the State in which the Project is located, employed by tank manufacturer and capable of assuming responsibility for structural design of tank, fittings, and supports, including foundations.
- C. Certifications:
 - 1. Water Heaters: NSF approved.
 - 2. Gas Water Heaters: ANSI Z21.10.1 and ANSI Z21.10.3.
 - 3. Indirect-Fired Gas Water Heaters: AHRI Directory of Certified Product Performance.
 - 4. Electric Water Heaters: UL listed and labeled to UL 174.
 - 5. Oil-Fired Water Heaters: To NFPA 31.
 - 6. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.
 - 7. Water Tanks: ASME labeled to ASME BPVC-VIII-1.

8. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

- A. See Division 01 Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for specified products. Complete forms in Owner's name and register with manufacturer

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Manufacturers:
 - a. Reference drawings for specifying schedules.
- B. Rack-Mounted, Tankless, Gas-Fired Water Heaters:
 1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 3. Water Inlet Pressure: From 30 psi to 150 psi.
 4. Supply Gas Type: Natural gas.
 5. Heater Type: Self-contained, wall-mounted unit capable of handling listed capacity, air intake valve, condensate solenoid drain valve, water-inlet strainer, removable thermally-insulated front panel, blower access cover, and threaded water, gas, and condensate pipe-end connections.
 6. Mount multiple units per manufacturer's instructions.
 7. Burner-Heat Exchanger: 316L stainless steel assembly with single flue passage, flue baffle, and draft hood; thermally insulated and encased in corrosion-resistant steel jacket; baked-on enamel finish.
 8. Safeties: Provide internal safeties for vent side, water flow, flame detection, fan speed, electrical load, and thermal load.
 9. Controls: Color touchscreen interface for internal controls and built-in gas pressure regulator; temperature range adjustable from 100 to 185 degrees F using safety pilot and thermocouple.
 10. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
 11. Accessories: Provide cold water inlet expansion tank, hot water recirculation pump, inlet ball valve, outlet ball valve, outlet ASME-rated temperature-pressure relief valve, and pipe-mounted thermometers.
 12. Electrical Load: 120 VAC, single phase.
- C. Commercial Gas-Fired Water Heaters:
 1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 2. Type: Automatic, natural gas-fired, vertical storage.
 3. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 4. Performance:
 - a. Reference drawings for performance requirements.
 5. Tank: Antimicrobial-infused, enamel-lined, welded steel, ASME labeled; multiple flue passages, 4-inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
 6. Accessories:

- a. Drain valve.
- b. Anode: Magnesium.
- c. Temperature and Pressure Relief Valve: ASME labeled.

A. REFERENCE DRAWINGS FOR SPECIFYING SCHEDULES.

A. REFERENCE DRAWINGS FOR SPECIFYING SCHEDULES.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.
- B. Electrical Work: Provide <> control and protective devices with associated wiring to interconnect related interfaced devices required for specified operation.
- C. Coordinate system, equipment, and piping work with applicable electrical support interconnections as included or provided by other trades.

3.02 CLEANING

- A. See Section Division 01 for additional requirements.
- B. Clean interior of water tanks and disinfect in accordance with AWWA C652.

END OF SECTION

**SECTION 22 40 00
PLUMBING FIXTURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tank type water closets.
- B. Wall hung urinals.
- C. Lavatories.
- D. Under-lavatory pipe supply covers.
- E. Bi-level, electric water coolers.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- C. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- D. ASME A112.18.1 - Plumbing Supply Fittings; 2024.
- E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- F. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2024.
- G. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- H. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- I. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- L. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide manufacturer's literature and data sheets for each product. Include materials of fabrication, rough-in requirements, location and sizes of connections, configurations, dimensions, finishes, features, and accessories.
 - 1. For electrically powered fixtures, include electrical characteristics.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on-site in factory packaging. Inspect for damage.

- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.06 WARRANTY

- A. Provide five year manufacturer warranty for electric water cooler.
- B. Refer to Division 01 for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Systems: Provide drinking water system components certified as complying with NSF 61 and NSF 372.
- B. ADA: Where indicated to be ADA-compliant, provide fixtures complying with ADA Standards and ICC A117.1.
- C. Maximum Fixture Supply Pressure: 80 psi unless stated otherwise.

2.02 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for installation of plumbing systems.
- B. Perform work in accordance with local health department regulations.
- C. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 TANK TYPE WATER CLOSETS

- A. Manufacturers:
 - a. Reference drawings for specifying schedules.
- B. Floor-Mounted Bowl (ADA Compliant):
 - 1. ASME A112.19.2; siphon jet, vitreous china, 16.5 inches high, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandalproof cover locking device.
 - 2. Water Consumption: 1.6 gal per flush, maximum.
- C. Floor-Mounted Bowl:
 - 1. ASME A112.19.2; vitreous china reverse trap, close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps.
 - 2. Water Consumption: 1.6 gal per flush, maximum.
- D. Pressure-Assisted Flush Systems:
 - 1. Provide pressurized wash down vessel and components.
 - 2. Water Consumption: 1.6 gal per flush.
 - 3. Manufacturers:
 - a. Reference drawings for specifying schedules.
- E. Toilet Seats:
 - 1. Plastic: Solid, white, elongated, open front, hinged seat cover, extended back with self-sustaining hinges, and brass bolts with covers.
 - 2. Manufacturers:
 - a. Reference drawings for specifying schedules.

2.04 WALL HUNG URINALS

- A. Manufacturers:
 - a. Reference drawings for specifying schedules.
- B. Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.

1. Consumption Volume: 1.0 gal per flush, maximum.
 2. Flush Style: Washout.
 3. Flush Valve: Exposed (top spud).
 4. Flush Operation: Manual, oscillating handle.
 5. Trapway Outlet: Integral.
 6. Removable stainless steel strainer.
 7. Supply Size: 3/4 inch.
 8. Outlet Size and Location: 2 inches, rear side.
- C. Flush Valves:
1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 2. Manual Operated:
 - a. Type: ASME A112.18.1 or ASME A112.19.5; diaphragm type, complete with vacuum breaker stops, and accessories.
 - b. Supplied Volume Capacity: 1.0 gal per flush.
 3. Exposed Type: Chrome-plated, escutcheon, integral screwdriver stop.
- D. Urinal Carriers:
1. Manufacturers:
 - a. Reference drawings for specifying schedules.
 2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.05 LAVATORIES

- A. Manufacturers:
- a. Reference drawings for specifying schedules.
- B. Wall-Hung Basin:
1. Vitreous China: ASME A112.19.2; white, rectangular commercial-grade sink with predrilled holes, rear-center drain, front overflow, and concealed carrier arm channels. Size as indicated on drawings with 4-inch centerset spacing.
 2. Carrier:
 - a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs.
 - b. Manufacturers:
 - a. Reference drawings for specifying schedules.
- C. Supply Faucet:
1. Single-Lever Handle, Supply Faucet: ASME A112.18.1; deck-mount, ceramic cartridge disc valve, and maximum flow of 0.5 gpm, low-flow.
- D. Accessories:
1. Chrome-plated 17 gauge, 0.0538 inch brass P-trap with clean-out plug, slip nuts, and arm with escutcheon.
 2. Braided hot and cold water supply lines.
 3. Loose-key stops.

2.06 UNDER-LAVATORY PIPE SUPPLY COVERS

- A. Manufacturers:
- a. Reference drawings for specifying schedules.
- B. General:
1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
 2. Adhesives, sewing threads and two ply laminated materials are prohibited.

3. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
 - a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - b. Comply with ICC A117.1.

2.07 BI-LEVEL, ELECTRIC WATER COOLERS

- A. Manufacturers:
 - a. Reference drawings for specifying schedules.
- B. Water Cooler: Bi-level, electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt and vandal resistant bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser.
 1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
 2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.
- C. Bottle Filler: Materials to match fountain.
- D. Accessories:
 1. Manufacturer's recommended wall carrier.
 2. Chrome-plated 17 gauge, 0.0538 inch brass P-trap, with slip nuts.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify walls, floors, and finishes are prepared and ready for installation of fixtures.
- B. Verify rough-ins for field connections match sizes and locations shown on drawings.
- C. Verify electric power is available and of the correct characteristics.
- D. Review casework and countertop shop drawings. Confirm locations and sizes of fixtures and openings before rough-in and installation.
- E. Verify casework and countertops are prepared and ready for installation of fixtures.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install components level and plumb.
- C. Secure fixtures in place.
- D. Install flexible supplies to fixtures. Provide supply stops, reducers, and escutcheons.
- E. Install wall-mounted fixtures, trim, and accessories at heights indicated on drawings.

3.03 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Repair or replace damaged or defective products.
- C. Test fixtures after installation to verify operation. Correct deficiencies.

3.04 ADJUSTING

- A. Adjust stops and valves so fixtures operate without splashing, noise, or overflow.

3.05 CLEANING

- A. Clean plumbing fixtures to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.06 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.

3.07 SCHEDULES

- A. Fixture Heights: Install fixtures to heights above finished floor as indicated on the architectural drawings.

END OF SECTION

SECTION 23 01 30.51
HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC equipment and related components.

1.02 RELATED REQUIREMENTS

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

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.

1.04 REFERENCE STANDARDS

- A. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System; 2021.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

2.02 SURFACE TREATMENTS

- A. Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.

- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Obtain Owner's approval of proposed temporary locations for large equipment.
- E. Designate a decontamination area and obtain Owner's approval.
- F. If unforeseen mold or other biological contamination is encountered, notify Engineer/Architect immediately, identifying areas affected and extent and type of contamination.

3.02 EXAMINATION

- A. Inspect the system as required to determine appropriate methods, tools, equipment, and protection.
- B. Start of cleaning work constitutes acceptance of existing conditions.
- C. When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.
- D. Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

3.03 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
 - 3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.04 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- D. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- E. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.

- F. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.05 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.06 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Notify Engineer/Architect when cleaned components are ready for inspection.
- D. When directed, re-clean components until they pass.
- E. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.07 ANTI-MICROBIAL TREATMENT

- A. When directed, apply anti-microbial treatment to internal surfaces.
- B. Apply anti-microbial agent after removal of surface deposits and debris.
- C. Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.
- D. Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

3.08 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.09 WASTE MANAGEMENT

- A. Double-bag waste and debris in 6 mil, 0.006 inch thick polyethylene plastic bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components.
- B. Retrofit piping cover system.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- E. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- I. FM (AG) - FM Approval Guide; Current Edition.
- J. MFMA-4 - Metal Framing Standards Publication; 2004.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- L. UL (DIR) - Online Certifications Directory; Current Edition.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 5. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03.
- 1.05 QUALITY ASSURANCE
- A. Comply with applicable building code.
- B. Installer Qualifications for Field-Welding: As specified in Division 05.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Prefabricated Trapeze-Framed Metal Strut Systems:
1. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
 2. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 3. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
- C. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
 2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Piping larger than 1 inch: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
- D. Thermal Insulated Pipe Supports:
1. General Requirements:

- a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
- 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
 - b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Thickness: 60 mil.
- E. Pipe Supports:
 - 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 2. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
- F. Roller Chairs:
 - 1. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
 - 2. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
 - 3. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.
- G. Beam Clamps:
 - 1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
 - 2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
 - 3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
 - 4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
 - 5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
 - 6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
 - 7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
 - 8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
- H. Riser Clamps:
 - 1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 - 2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 - 3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 - 4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
 - 5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

- I. Strut Clamps:
 - 1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
- J. Pipe Hangers:
 - 1. Split Ring Hangers:
 - a. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
 - b. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 - c. Provide hanger rod and nuts of the same type and material for a given pipe run.
 - d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
 - 2. Clevis Hangers, Adjustable:
 - a. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
 - b. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch.
- K. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- L. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 - 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- M. Pipe Shields for Insulated Piping:
 - 1. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Minimum Service Temperature: Minus 40 degrees F.
 - e. Maximum Service Temperature: 178 degrees F.
 - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- N. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Hollow Stud Walls: Use toggle bolts.
 - 6. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
 - 7. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

2.02 RETROFIT PIPING COVER SYSTEM

- A. General Requirements:

1. Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, maximum, when tested in accordance with ASTM E84 or UL 723.
- B. Materials:
 1. Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors for use with CPVC, steel, and copper piping systems.
 2. Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin material, paintable finish.
 3. Unit Length: 7.5 feet.
 4. Provide coupling fittings for joining units end to end and prefabricated inside and outside corner fittings and end caps as required.
 5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Engineer/Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Engineer/Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Division 01 for additional requirements.
- B. Inspect support and attachment components for damage and defects.

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

END OF SECTION

SECTION 23 05 48
VIBRATION CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03.

1.05 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. 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. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.

2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 3. Select vibration isolators for outdoor equipment to comply with wind design requirements.
 4. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation: As indicated on drawings.
- E. Piping Isolation:
1. Provide vibration isolators for piping supports:
 - a. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
 3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
 4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

- A. Vibration-Isolated Structural Steel Bases:
1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
- B. Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 2. Minimum Base Depth: 6 inches.
 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
 5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Division 03.

2.03 VIBRATION ISOLATORS

- A. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
- B. Vibration Isolators for Nonseismic Applications:
1. Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.

- b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
- 2. Resilient Material Isolator Mounts, Nonseismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
- 3. Open (Unhoused) Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
- 4. Housed Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
 - b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
 - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - d. Furnished with integral leveling device for positioning and securing supported equipment.
- 5. Restrained Spring Isolators, Nonseismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
 - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
- 6. Resilient Material Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
- 7. Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for

- the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
- b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.04 ACOUSTICAL AND VIBRATION ISOLATORS

- A. General Requirements:
 - 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 - 5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 - 6. Adjust isolators to be free of isolation short circuits during normal operation.
 - 7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, for additional requirements.

- B. Inspect vibration isolation control components for damage and defects.
- C. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify required clearance beneath vibration-isolated equipment support bases.
 - 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Pipe markers.
- F. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 09, Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Control Panels: Nameplates.
- C. Dampers: Ceiling tacks, where located above lay-in ceiling.
- D. Ductwork: Nameplates.
- E. Instrumentation: Tags.
- F. Major Control Components: Nameplates.
- G. Piping: Tags.
- H. Pumps: Nameplates.
- I. Small-sized Equipment: Tags.
- J. Thermostats: Nameplates.

2.02 NAMEPLATES

- A. Letter Color: White.
- B. Letter Height: 1/4 inch.
- C. Background Color: Black.
- D. Plastic: Comply with ASTM D709.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 ADHESIVE-BACKED DUCT MARKERS

- A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.
- B. Style: Individual Label.
- C. Color: Yellow/Black.
- D. Letter Height: 1 inch..

2.05 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. Over 2" Outside Diameter of Insulation or Pipe: 12 inch long color field, 1 inch high letters.
 - 4. Ductwork and Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors complying with ASME A13.1.

2.06 PIPE MARKERS

- A. Color: Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.
- E. Ammonia Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

2.07 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. HVAC Equipment: Yellow.
 - 2. Fire Dampers and Smoke Dampers: Red.
 - 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Division 09.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- I. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.
- C. Sound measurement of equipment operating conditions.
- D. Vibration measurement of equipment operating conditions.
- E. Commissioning activities.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.04 SUBMITTALS

- A. See Division 01, for submittal procedures.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - d. Final test report forms to be used.
 - e. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer/Architect and for inclusion in operating and maintenance manuals.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 5. Units of Measure: Report data in I-P (inch-pound) units only.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA (TAB).
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer/Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.07 COMMISSIONING

- A. See Division 01 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
- D. Furnish to the Commissioning Provider, upon request, any data gathered but not shown in the final TAB report.
- E. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for ____ percent of the air handlers plus a random sample equivalent to ____ percent of the final TAB report data as directed by Commissioning Provider.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Provider.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - c. Temperatures: Deviation of more than one degree F.
 - d. Air Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- F. In the presence of the Commissioning Provider, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.

3.08 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Packaged Roof Top Heating/Cooling Units.
 - 2. Terminal Heat Transfer Units.
 - 3. Air Handling Units.
 - 4. Fans.
 - 5. Air Filters.
 - 6. Air Terminal Units.
 - 7. Air Inlets and Outlets.

3.09 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer.
 - 2. Model/Frame.
 - 3. HP/BHP.
 - 4. Phase, voltage, amperage; nameplate, actual, no load.
 - 5. RPM.
 - 6. Service factor.
 - 7. Starter size, rating, heater elements.
 - 8. Sheave Make/Size/Bore.
- B. Combustion Equipment:
 - 1. Heater manufacturer.
 - 2. Model number.
 - 3. Serial number.
 - 4. Firing rate.
 - 5. Overfire draft.
 - 6. Gas meter timing dial size.
 - 7. Gas meter time per revolution.
 - 8. Gas pressure at meter outlet.
 - 9. Gas flow rate.
 - 10. Heat input.
 - 11. Burner manifold gas pressure.
 - 12. Percent carbon monoxide (CO).
 - 13. Percent carbon dioxide (CO₂).
 - 14. Percent oxygen (O₂).
 - 15. Percent excess air.
 - 16. Flue gas temperature at outlet.
 - 17. Ambient temperature.
 - 18. Net stack temperature.
 - 19. Percent stack loss.
 - 20. Percent combustion efficiency.
 - 21. Heat output.
- C. Air Cooled Condensers:
 - 1. Identification/number.
 - 2. Location.
 - 3. Manufacturer.
 - 4. Model number.
 - 5. Serial number.
 - 6. Entering DB air temperature, design and actual.
 - 7. Leaving DB air temperature, design and actual.
 - 8. Number of compressors.
- D. Air Moving Equipment:
 - 1. Location.
 - 2. Manufacturer.
 - 3. Model number.
 - 4. Serial number.
 - 5. Arrangement/Class/Discharge.
 - 6. Air flow, specified and actual.
 - 7. Return air flow, specified and actual.
 - 8. Outside air flow, specified and actual.
 - 9. Total static pressure (total external), specified and actual.

10. Inlet pressure.
 11. Discharge pressure.
 12. Sheave Make/Size/Bore.
 13. Number of Belts/Make/Size.
 14. Fan RPM.
- E. Return Air/Outside Air:
1. Identification/location.
 2. Design air flow.
 3. Actual air flow.
 4. Design return air flow.
 5. Actual return air flow.
 6. Design outside air flow.
 7. Actual outside air flow.
 8. Return air temperature.
 9. Outside air temperature.
 10. Required mixed air temperature.
 11. Actual mixed air temperature.
 12. Design outside/return air ratio.
 13. Actual outside/return air ratio.
- F. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.
- G. Duct Traverses:
1. System zone/branch.
 2. Duct size.
 3. Area.
 4. Design velocity.
 5. Design air flow.
 6. Test velocity.
 7. Test air flow.
 8. Duct static pressure.
 9. Air temperature.
 10. Air correction factor.
- H. Duct Leak Tests:
1. Description of ductwork under test.
 2. Duct design operating pressure.
 3. Duct design test static pressure.
 4. Duct capacity, air flow.
 5. Maximum allowable leakage duct capacity times leak factor.
 6. Test apparatus:
 - a. Blower.
 - b. Orifice, tube size.

- c. Orifice size.
 - d. Calibrated.
- 7. Test static pressure.
- 8. Test orifice differential pressure.
- 9. Leakage.
- I. Flow Measuring Stations:
 - 1. Identification/number.
 - 2. Location.
 - 3. Size.
 - 4. Manufacturer.
 - 5. Model number.
 - 6. Serial number.
 - 7. Design Flow rate.
 - 8. Design pressure drop.
 - 9. Actual/final pressure drop.
 - 10. Actual/final flow rate.
 - 11. Station calibrated setting.
- J. Air Distribution Tests:
 - 1. Air terminal number.
 - 2. Room number/location.
 - 3. Terminal type.
 - 4. Terminal size.
 - 5. Area factor.
 - 6. Design velocity.
 - 7. Design air flow.
 - 8. Test (final) velocity.
 - 9. Test (final) air flow.
 - 10. Percent of design air flow.
- K. Sound Level Reports:
 - 1. Location.
 - 2. Octave bands - equipment off.
 - 3. Octave bands - equipment on.
- L. Vibration Tests:
 - 1. Location of points:
 - a. Fan bearing, drive end.
 - b. Fan bearing, opposite end.
 - c. Motor bearing, center (if applicable).
 - d. Motor bearing, drive end.
 - e. Motor bearing, opposite end.
 - f. Casing (bottom or top).
 - g. Casing (side).
 - h. Duct after flexible connection (discharge).
 - i. Duct after flexible connection (suction).
 - 2. Test readings:
 - a. Horizontal, velocity and displacement.
 - b. Vertical, velocity and displacement.
 - c. Axial, velocity and displacement.
 - 3. Normally acceptable readings, velocity and acceleration.
 - 4. Unusual conditions at time of test.
 - 5. Vibration source (if non-complying).

END OF SECTION

**SECTION 23 07 13
DUCT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Weather barrier coatings.
- D. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- H. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation; 2024.
- I. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).
- J. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers; 2015 (Reapproved 2022).
- K. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- L. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- M. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- O. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

- P. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- Q. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- R. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- S. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K value: 0.26 at 75 degrees F, when tested in accordance with ASTM C518.
- B. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure-sensitive tape.
- C. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- D. Indoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- E. Outdoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.03 GLASS FIBER, RIGID

- A. Insulation: ASTM C612; rigid, noncombustible blanket.

1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 2. Maximum Service Temperature: 450 degrees F.
 3. Maximum Water Vapor Absorption: 5.0 percent.
 4. Maximum Density: 8.0 pcf.
- B. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure-sensitive tape.
- C. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- D. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- 2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION
- A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 180 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- C. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.
- 2.05 FIRE RATED DUCT WRAP INSULATION
- A. Insulation: High temperature, flexible, blanket insulation with FSK jacket, for ventiation and grease duct applications. Complying with ASTM E2336, ASTM E136, and ISO6944.
1. Thickness: 1.5 inches
 2. Maximum Service Temperature: 2000°F
 3. Fire Resistance: For use in 1 or 2 hour fire resistant systems.
 4. Flame and smoke spread index of <50
- 2.06 WEATHER BARRIER COATINGS
- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 2. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
 3. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 4. Color: As selected by Architect.
- 2.07 JACKETING AND ACCESSORIES
- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
- B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.
- C. Aluminum Jacket:

1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 2. Thickness: 0.016 inch sheet.
 3. Finish: Smooth.
 4. Joining: Longitudinal slip joints and 2 inch laps.
 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- D. Aluminum-Foil Laminate Jacket:
1. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
 2. Comply with ASTM C1775.
- E. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.
1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
 2. Thickness: 34 mil, 0.034 inch.
 3. Water Vapor Transmission: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 4. Mold Resistance: Pass when tested in accordance with ASTM C1338.
 5. Emissivity: 0.30 when tested in accordance with ASTM C1371.
- F. Reinforced Tape:
1. FSK tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
 2. Comply with UL 723 or ASTM E84.
 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.

2.08 DUCT LINER

- A. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 180 degrees F.
 3. Fungal Resistance: No growth when tested according to ASTM G21.
 4. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F.
 5. Erosion Resistance: Does not show evidence of breaking away, flaking off, or delamination at velocities of 10,000 fpm when tested in accordance with ASTM C1071.
 6. Connection: Waterproof vapor barrier adhesive.
- B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with ASTM C916.
- C. Phenolic Rigid Foam Insulation: Rigid foam board constructed from fiber-free phenolic insulation complying with ASTM C1126.
1. Vapor Barrier: Faced on both sides with factory-applied aluminum foil vapor barrier.
 2. Minimum Operating Temperature: Capable of operating at a temperature of minus 5 degrees F.
 3. Maximum Operating Temperature: Capable of operating at a temperature of 175 degrees F.
 4. Mold Resistance: Resistant to spread of mold when tested according to UL 181.
 5. Rated Air Velocity: At 5,000 fpm or greater material does not show evidence of erosion when tested in accordance with UL 181.
- D. Adhesive: Waterproof, fire-retardant type, ASTM C916.
- E. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Insulated Ducts Conveying Air Below Ambient Temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated Ducts Conveying Air Above Ambient Temperature:
 - 1. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- F. Slope exterior ductwork to shed water.
- G. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.
 - 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- H. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 90 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

- A. Ducts Requiring Insulation:
 - 1. Interior Ductwork Applications:
 - a. Supply Air Ductwork
 - b. Outdoor Air Ductwork
 - c. Return Air Ductwork Located in Unconditioned Spaces
 - d. Exhaust Air Ductwork between Isolation Damper and Penetration of Building Exterior.
 - 2. Exterior Ductwork Applications:
 - a. Supply Air Ductwork
 - b. Return Air Ductwork

- B. Items Not Insulated:
 - 1. Flexible Connectors
 - 2. Factory-Insulated:
 - a. Flexible Ductwork
 - b. Plenums
 - c. Casings
 - d. Access Panels/Doors
- C. Interior Ductwork Insulation Schedule:
 - 1. Concealed duct insulation shall be one of the following:
 - a. 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.
 - b. 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.
 - 2. Exposed duct insulation shall be one of the following:
 - a. Double walled duct:
 - 1) Interstitial insulation with an R value of R-6 or better.
 - b. Single walled duct:
 - 1) Flexible Elastomeric: 1 inch thick with an R value of R-6 or better.
 - 2) Polyolefin: 1 inch thick with an R value of R-6 or better.
- D. Exterior Ductwork Insulation Schedule:
 - 1. Mineral-Fiber Blanket: 3 inches and 0.75-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.
 - 2. Mineral-Fiber Board: 3 inches thick and 2-lb/cu. ft. nominal density or equivalent combination of thickness and density to achieve an R value of R-8 or better.

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Weather barrier coatings.
- D. Jacketing and accessories.
- E. Engineered wall outlet seals and refrigerant piping insulation protection.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- C. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- D. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
- E. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- F. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2022.
- G. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension; 2016 (Reapproved 2021).
- H. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
- I. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- L. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

- N. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- O. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- P. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- Q. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 180 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- C. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

2.03 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 - 2. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
 - 3. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 - 4. Color: As selected by Architect.

2.04 JACKETING AND ACCESSORIES

- A. PVC Plastic.
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
 - 2. Covering Adhesive Mastic: Compatible with insulation.
- B. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch sheet.
 - 3. Type: Factory-applied, self-adhesive jacketing.
 - 4. Finish: Smooth.
 - 5. Joining: Longitudinal slip joints and 2 inch laps.
 - 6. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
- C. Reinforced Tape:
 - 1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 - 2. Comply with UL 723, ASTM E84.
 - 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
- D. Plain Foil Tape:
 - 1. Aluminum foil with pressure-sensitive adhesive on paper release liner.
 - 2. Finish: Plain foil.
- E. Vapor Barrier Membranes: ASTM C1136, Type IX.
 - 1. Multilayer Laminate Vapor Barrier:
 - a. Provide multilayer laminate with 1.0 mil, 0.001 inch foil, reversible.
 - b. Thickness: 2.4 mil, 0.002 inch.
 - c. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Manufacturers:
 - 1) Polyguard Products; ZERO-PERM: www.polyguardproducts.com/#sle.
 - 2. Rubberized Asphalt Vapor Barrier:
 - a. Thickness: 30 mil, 0.030 inch.
 - b. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Manufacturers:
 - 1) Polyguard Products; Insulrap 30 NG: www.polyguardproducts.com/#sle.

2.05 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

- A. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
 - 1. Outlet Cover Color: Gray.
 - 2. Water Penetration: Comply with ASTM E331.
 - 3. Air Leakage: Comply with ASTM E283/E283M.
 - 4. Air Permeance: Comply with ASTM E2178.

- B. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
 - 1. PVC Insulation Cover Color: Black with full-length velcro fastener.
 - 2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
 - 3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
 - 4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
 - 5. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.
 - 6. Carbon Arc Light Exposure: Comply with ASTM G153.
 - 7. Tensile Strength After UV Exposure and Water Immersion: Comply with ASTM D412.
 - 8. Water Absorption of Plastics: Comply with ASTM D570.

2.06 ACCESSORIES

- A. General Requirements:
 - 1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
 - 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
 - 3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
 - 4. Supply materials that are asbestos free.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- E. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Division 07.
- F. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- G. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV-resistant finish for flexible elastomeric cellular insulation without jacketing.

END OF SECTION

**SECTION 23 09 13
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Control panels.
- B. Wall-, Surface-, and Duct-Mounted Sensors:
 - 1. Temperature sensors.
 - 2. Humidity sensors.
 - 3. IAQ (indoor air quality) sensors.
 - 4. Building static pressure transmitters.
 - 5. Airflow meters; pitot tubes.
- C. Thermostats:
 - 1. Electric thermostats.
 - 2. Line voltage thermostats.
 - 3. Room-mount thermostat accessories.
- D. Level Instruments:
- E. Level Switches:
 - 1. Float Sensors:
 - a. Float switch.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.
- C. Section 26 27 26 - Wiring Devices: Elevation of exposed components.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2026).
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA BS 31032 - Residential Controls—Electrical Wall-Mounted Room Thermostats; 2025.

1.04 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

2.03 WALL-, SURFACE-, AND DUCT-MOUNT SENSORS

- A. Temperature Sensors:
 - 1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
 - 2. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
 - 3. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 - 4. Temperature Sensing Device: Compatible with project DDC controllers.
 - 5. Performance Characteristics:
 - a. RTD:
 - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.
 - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
 - 3) Chilled Water Accuracy: Plus/minus 0.50 degrees F minimum.
 - 4) All Other Accuracy: Plus/minus 0.75 degrees F minimum.
 - 5) Range: Minus 40 degrees F through 220 degrees F minimum.
 - b. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
 - 2) Range: Minus 25 degrees F through 122 degrees F minimum.
 - 3) Heat Dissipation Constant: 2.7 mW per degree C.
 - c. Temperature Transmitter:
 - 1) Accuracy: 0.10 degree F minimum or plus/minus 0.20 percent of span.
 - d. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - 2) Use RTD type sensors for extended ranges beyond minus 30 to 230 degrees F.
 - 3) Use temperature transmitters in conjunction with RTDs when RTDs are incompatible with DDC controller direct temperature input.
 - e. Wire Resistance:
 - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
 - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
 - f. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
 - g. Room Temperature Sensors:
 - 1) Construct for surface or wall box mounting.
- B. Humidity Sensors, Duct-Mounted:
 - 1. Digitally profiled thin-film capacitive sensor probe extended from die-cast metal, weather-proof plastic or metal housing designed for duct mounting.
 - 2. Measuring Scale: 0 to 100 percent RH, noncondensing, temperature compensated.
 - 3. Hardwired Output: Two-wire, 4 to 20 mA, loop powered.
 - 4. Accuracy: Plus/minus 1 percent between 20 to 40 percent RH linear range, NIST traceable with multi-point calibration.
 - 5. Temperature Sensor, Combined: Platinum RTD.
- C. IAQ (Indoor Air Quality) Sensors:
 - 1. Form Factor: Surface mounted, desk mounted, or single-gang electrical-box-mounted module made of high-impact plastic or other resilient material.
 - 2. Temperature Sensor:

- a. Solid-state, integrated circuit type, 32 to 122 deg F range.
 - b. Accuracy: Plus/minus two percent within 0.1 deg resolution.
- 3. CO2 (Carbon Dioxide) Monitoring Sensor:
 - a. Non-dispersive infrared (NDIR) type, 0 to 100 %RH range.
 - b. Accuracy: Plus/minus 30 ppm within three percent of measured value.
- 4. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
- D. Building Static Pressure Transmitters:
 - 1. Single port for direct or tubing connection into wall or ceiling static pressure tap, direct acting, double bell, scale range 0.01 to 6.0 in-wc positive or negative, and sensitivity of 0.0005 in-wc. Transmit electronic signal to receiver with matching scale range.
- E. Airflow Meters; Pitot Tubes:
 - 1. Sensor Type: Provide duct-inserted probe, duct-inserted pitot-tube assembly, and wall-mounted assembly for outside air with built-in transmitter.
 - 2. Flow Range: Equivalent velocity pressure required to match scheduled flow range with a 100 to 1 signal turndown ratio.
 - 3. Linearity: 0.1 percent of calibrated span.
 - 4. Minimum Overpressure: 150 percent over highest range value.
 - 5. Output: Two-wire, 4 to 20 mA.
 - 6. Access Box: NEMA EN 10250, Type 1 with hinged cover housing and cable access ports.

2.04 THERMOSTATS

- A. Electric Thermostats:
 - 1. Type: NEMA BS 31032, 24 volts, with setback/setup temperature control.
 - 2. Service: Cooling only.
 - 3. Covers: Locking with set point adjustment, with thermometer.
- B. Line Voltage Thermostats:
 - 1. Dead Band: Maximum 2 degrees F.
 - 2. Cover: Locking with set point adjustment, with thermometer.
 - 3. Rating: Motor load.
- C. Room-Mounted Thermostat Accessories:
 - 1. Thermostat Covers: Brushed aluminum.
 - 2. Insulating Bases: For thermostats located on exterior walls.

2.05 LEVEL INSTRUMENTS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- F. Ensure installation of components is complementary to installation of similar components.
- G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches above floor. Align with lighting switches and humidistats; see Division 26.
- C. Provide guards on thermostats in entrances and public areas.
- D. Provide conduit and electrical wiring in accordance with Division 26. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MAINTENANCE

- A. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- B. Provide complete service of controls systems, including call backs, and submit written report of each service call.

END OF SECTION

**SECTION 23 11 23
FACILITY NATURAL-GAS PIPING**

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

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

1.02 REFERENCE STANDARDS

- A. ANSI LC 4/CSA 6.32 - Press-Connect Metallic Fittings and Valves for Use in Fuel Gas Distribution Systems; 2022.
- B. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.
- C. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.
- D. ANSI Z223.1 - National Fuel Gas Code; 2024.
- E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- H. ASME B31.1 - Power Piping; 2024.
- I. ASME B31.9 - Building Services Piping; 2025.
- J. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- L. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.
- M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- O. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2024.
- P. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- Q. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- R. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- S. IAPMO (UMC) - 2024 Uniform Mechanical Code; 2024.
- T. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- U. ICC (IFGC) - International Fuel Gas Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- V. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- W. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).

- X. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
 - Y. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
 - Z. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- 1.03 SUBMITTALS
- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- 1.04 QUALITY ASSURANCE
- A. Perform work in accordance with applicable codes.
 - B. Valves: Manufacturer's name and pressure rating marked on valve body.
 - C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
 - D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
 - E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
 - B. Provide temporary protective coating on cast iron and steel valves.
 - C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 - D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- 1.06 FIELD CONDITIONS
- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

- 2.01 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING
- A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.
 - 3. Mechanical Press Sealed Fittings: ANSI LC 4/CSA 6.32; ICC (IFGC) approved, and IAPMO (UPC) or IAPMO (UMC) approved, with HNBR seals.
 - 4. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
 - B. Copper Tubing: Listed, ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
 - 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.
 - 3. Mechanical Press Sealed Fittings: ANSI LC 4/CSA 6.32; ICC (IFGC) approved, and IAPMO (UPC) or IAPMO (UMC) approved, with HNBR seals.
- 2.02 NATURAL GAS PIPING, ABOVE GRADE
- A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 2. Joints: Threaded or welded to ASME B31.1.
 3. Mechanical Press Sealed Fittings: ANSI LC 4/CSA 6.32; ICC (IFGC) approved, and IAPMO (UPC) or IAPMO (UMC) approved, with HNBR seals.
- B. Copper Tube: Listed, ASTM B88 (ASTM B88M), Type K (A), annealed.
1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.
 3. Mechanical Press Sealed Fittings: ANSI LC 4/CSA 6.32; ICC (IFGC) approved, and IAPMO (UPC) or IAPMO (UMC) approved, with HNBR seals.
- 2.03 FLANGES, UNIONS, AND COUPLINGS
- A. Unions for Pipe Sizes 3 Inches and Under:
1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- 2.04 PIPE HANGERS AND SUPPORTS
- A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
- B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 6. Other Types: As required.
- 2.05 BALL VALVES
- A. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, brass, bronze, or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blowout proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.
- 2.06 STRAINERS
- A. Size 2 inch and Under:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- 2.07 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS
- A. Compliance Requirements:
1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
 2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.
- B. Materials in Contact With Gas:

1. Housing: Aluminum, steel (free of non-ferrous metals).
 2. Seals and Diaphragms: NBR-based rubber.
- C. Provide regulators utilized indoors with manufacturer's vent limiting device.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed.
- H. Establish elevations of buried piping outside the building to ensure not less than 1'-0" ft of cover.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- K. Install valves with stems upright or horizontal, not inverted.
- L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.
- M. Sleeve pipes passing through partitions, walls and floors.
- N. Inserts:
1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- O. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.
8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.04 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball valves for throttling, bypass, or manual flow control services.

3.05 SERVICE CONNECTIONS

- A. Provide new gas service complete with gas meter and regulators . Coordinate new gas service with local natural gas company and coordinate site work with the civil engineering drawings and the site contractor. Gas service distribution piping to have initial minimum pressure of 2 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.06 SCHEDULES

- A. Pipe Hanger Spacing:
 1. Metal Piping:
 - a. Pipe Size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inches to 2 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe Size: 2-1/2 inches to 3 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.

END OF SECTION

**SECTION 23 23 00
REFRIGERANT PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure regulators.
- H. Pressure relief valves.
- I. Filter-driers.
- J. Solenoid valves.
- K. Expansion valves.
- L. Receivers.
- M. Flexible connections.
- N. Exterior penetration accessories.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers; 2005.
- B. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers; 2009.
- C. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers; 2009.
- D. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers; 2013 (Reapproved 2014).
- E. AHRI 760 (I-P) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants; 2014.
- F. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Errata (2025).
- G. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2024, with Addendum (2025).
- H. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- I. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2024.
- J. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- K. ASME B31.9 - Building Services Piping; 2025.
- L. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.
- M. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.
- P. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- Q. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- R. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- S. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- T. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- U. IAPMO (UMC) - 2024 Uniform Mechanical Code; 2024.
- V. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- W. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- X. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.
- Y. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 8 years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure integrity of system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
- D. Valves:
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gauge taps at compressor inlet and outlet.
 - 3. Use check valves on compressor discharge.
- E. Strainers:
 - 1. Use line size strainer upstream of each automatic valve.

2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 3. Use shut-off valve on each side of strainer.
- F. Filter-Driers:
1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
 2. Use a filter-drier on suction line just ahead of compressor.
 3. Use sealed filter-driers in lines smaller than 1/2 inch outside diameter.
 4. Use sealed filter-driers in low temperature systems.
 5. Use sealed filter-driers in systems utilizing hermetic compressors.
 6. Use replaceable core filter-driers in lines of 1/2 inch outside diameter or greater.
 7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
 8. Use filter-driers for each solenoid valve.
- G. Solenoid Valves:
1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
 2. Use in liquid line of single or multiple evaporator systems.
- H. Receivers:
1. Use on systems with long piping runs.
- I. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

2.02 REGULATORY REQUIREMENTS

- A. Comply with ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME BPVC-IX.
- D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.03 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 1. Fittings: ASME B16.22 wrought copper.
 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
 3. Mechanical Press Fittings: UL 207 listed, ICC (IMC) and IAPMO (UMC) approved, with HNBR seals.
- B. Copper Tube to 7/8-inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 1. Fittings: ASME B16.26 cast copper.
 2. Joints: Flared.
 3. Mechanical Press Sealed Fittings: UL 207 listed, ICC (IMC) and IAPMO (UMC) approved, with HNBR seals.
- C. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 2. Joints: Welded in accordance with AWS D1.1/D1.1M.
- D. Pipe Supports and Anchors:
 1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
10. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 REFRIGERANT

- A. Refrigerant: R 32 (difluoromethane) as defined in ASHRAE Std 34.
- B. Refrigerant R 454B (R-32/1234y) as defined in ASHRAE Std 34

2.05 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.06 VALVES

- A. Diaphragm Packless Valves:
 1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, soldered or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- B. Packed Angle Valves:
 1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, soldered or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- C. Ball Valves:
 1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

2.07 STRAINERS

- A. Straight Line or Angle Line Type:
 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.08 CHECK VALVES

- A. Globe Type:
 1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.
- B. Straight Through Type:
 1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.09 PRESSURE REGULATORS

- A. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

2.10 PRESSURE RELIEF VALVES

- A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

2.11 FILTER-DRIERS

- A. Performance:
 - 1. Flow Capacity - Liquid Line: ____ ton, minimum, rated in accordance with AHRI 710 (I-P) (AHRI 711 (SI)).
 - 2. Flow Capacity - Suction Line: ____ ton, minimum, rated in accordance with AHRI 730 (I-P).
 - 3. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
 - 4. Design Working Pressure: 350 psi, minimum.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
 - 1. Replaceable Core Type: Steel shell with removable cap.
 - 2. Sealed Type: Copper shell.
 - 3. Connections: As specified for applicable pipe type.

2.12 SOLENOID VALVES

- A. Valve: AHRI 760 (I-P), pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi.
- B. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.13 EXPANSION VALVES

- A. Angle or Straight Through Type: AHRI 760 (I-P); design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with nonreplaceable capillary tube and remote sensing bulb and remote bulb well.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.14 ELECTRONIC EXPANSION VALVES

- A. Valve:
 - 1. Brass body with flared or soldered connection, needle valve with floating needle and machined seat, stepper motor drive.
- B. Evaporation Control System:
 - 1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
- C. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low),

solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.15 RECEIVERS

- A. Internal Diameter 6 inch and Smaller:
 - 1. AHRI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- B. Internal Diameter Over 6 inch:
 - 1. AHRI 495, welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; 400 psi with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.16 FLEXIBLE CONNECTORS

- A. Corrugated stainless steel or bronze hose with single layer of exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

2.17 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.5.
 - 2. Comply with section 230529 "Hangars and supports for HVAC piping and equipment" for hangers, supports, and anchor devices
 - 3. Support horizontal piping as indicated.

- 4. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- 5. Place hangers within 12 inches of each horizontal elbow.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings. Coordinate size and location of access doors per appropriate Division 08 section.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- M. Insulate piping.
- N. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- O. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- P. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- Q. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- R. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- S. Fully charge completed system with refrigerant after testing.

3.03 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 525 psi. Perform final tests at 27 inches vacuum and 525 psi using electronic leak detector. Test to no leakage.

END OF SECTION

**SECTION 23 31 00
HVAC DUCTS AND CASINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.
- C. Ducts for kitchen exhaust applications.

1.02 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- D. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems; 2020.
- E. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- G. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- J. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
- K. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- L. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
- M. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated.
- C. Duct Shape and Material in accordance with Allowed Static Pressure Range:
 - 1. Round: Plus or minus 2 in-wc of galvanized steel.
 - 2. Rectangular: Plus or minus 1/2 in-wc of galvanized steel.
 - 3. Flexible Duct (Fabric and wire): Plus or minus 1/2 in-wc; see Section 23 37 00.
- D. Duct Sealing and Leakage in accordance with Static Pressure Class:
 - 1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:

- a. Supply Air connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units: 1 in-wc pressure class, galvanized steel.
 - b. Supply Air connected to Constant Volume Air Handling Units: 2 in-wc pressure class, galvanized steel.
 - c. Return and Relief Air: 1 in-wc pressure class, galvanized steel.
 - d. General Exhaust Air: 1 in-wc pressure class, galvanized steel.
- 2. Low Pressure Service: Up to 2 in-wc:
 - a. Seal: Class C, apply to seal off transverse joints.
 - b. Leakage:
 - 1) Rectangular: Class 24 or 24 cfm/100 sq ft.
 - 2) Round: Class 12 or 12 cfm/100 sq ft.
- E. Duct Fabrication Requirements:
 - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 - 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
 - 3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
 - 4. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
 - 5. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.

2.02 METAL DUCTS

- A. Material Requirements:
 - 1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Rectangular Metal Duct:
 - 1. Rectangular Single Wall: Rectangular spiral lock seam duct with galvanized steel outer wall.
- C. Round Metal Ducts:
 - 1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
 - 2. Round Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).
- D. Connectors, Fittings, Sealants, and Miscellaneous:
 - 1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
 - 2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
 - 3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
 - c. For Use with Flexible Ducts: UL labeled.
 - 4. Gasket Tape:

- a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
- 5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- 6. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:
 - a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - b. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - c. Other Types: As required.

2.03 FLEXIBLE DUCTS

- A. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form spiral helix.
 - 1. Insulation: R6 insulation with aluminized vapor barrier film.
 - 2. Pressure Rating: 10 in-wc positive and 1 in-wc negative.
 - 3. Maximum Velocity: 5500 fpm.
 - 4. Temperature Range: Minus 20 degrees F to 250 degrees F.

2.04 DUCTS FOR KITCHEN EXHAUST APPLICATIONS

- A. Provide ductwork, fittings, and appurtenances in accordance with NFPA 96, SMACNA (KVS), UL 1978, and UL 2221 requirements and guidelines.
- B. Class 1 duct for air with gas and grease particle exhaust at an air velocity of 1,500 to 2,500 fpm.
- C. Where ducts are not self-draining back to equipment, provide low-point drain pocket with the copper drain pipe to a sanitary sewer.
- D. Design, fabricate, and install liquidtight preventing exhaust leakage into building.
- E. Kitchen Hood and Grease Exhaust Duct:
 - 1. Fabricate in accordance with SMACNA (DCS), SMACNA (KVS), and NFPA 96.
 - 2. Rectangular, Single-Wall, Premanufactured Grease Exhaust Duct:
 - a. UL Listed and labeled to UL 1978.
 - b. Construct of 16-gauge, 0.059-inch sheet steel using continuous external welded joints in rectangular sections.
 - c. Construct of 18-gauge, 0.050-inch stainless steel using continuous external welded joints in rectangular sections.
 - 3. Grease Exhaust Duct Access Doors:
 - a. Listed when tested in accordance with UL 1978.
 - b. Provide with preinsulated door to comply with ASTM E2336.
 - c. Install hinged access doors where indicated or required for access for cleaning and inspection of duct.
 - d. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
 - e. Size: 12 by 12 inches.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.

- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- E. Flexible Ducts: Connect to metal ducts with mechanical fastener.
- F. Kitchen Hood Exhaust: Provide residue traps at the base of vertical risers with provisions for the cleanout.
- G. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- H. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Connect diffusers to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

END OF SECTION

**SECTION 23 33 00
AIR DUCT ACCESSORIES**

PART 1 GENERAL

- 1.01 SECTION INCLUDES
 - A. Air turning devices/extractors.
 - B. Backdraft dampers - metal.
 - C. Duct access doors.
 - D. Flexible duct connectors.
 - E. Volume control dampers.
- 1.02 RELATED REQUIREMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
 - B. Section 23 31 00 - HVAC Ducts and Casings.
- 1.03 REFERENCE STANDARDS
 - A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
 - B. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
 - C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- 1.04 SUBMITTALS
 - A. See Division 01 for submittal procedures.
 - B. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, and hardware used. Include electrical characteristics and connection requirements.
- 1.05 QUALITY ASSURANCE
 - A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- 1.06 DELIVERY, STORAGE, AND HANDLING
 - A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

- 2.01 AIR TURNING DEVICES/EXTRACTORS
 - A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.
- 2.02 BACKDRAFT DAMPERS - METAL
 - A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.
- 2.03 DUCT ACCESS DOORS
 - A. Fabricate in accordance with SMACNA (DCS) and as indicated.

- B. Access doors with sheet metal screw fasteners are not acceptable.

2.04 FLEXIBLE DUCT CONNECTORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.

2.05 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Single Blade Dampers:
 - 1. Fabricate for duct sizes up to 6 by 30 inch.
 - 2. Blade: 24 gauge, 0.0239 inch, minimum.
- C. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches. Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
 - 1. Blade: 18 gauge, 0.0478 inch, minimum.
- D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
- E. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.
- D. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- E. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

- G. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ceiling exhaust fans.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2025.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.
- E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- I. UL 705 - Power Ventilators; Current Edition, Including All Revisions.
- J. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. UL Compliance: UL 705, listed, labeled, designed, manufactured, and tested.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- G. Enclosed Safety Switches: Comply with NEMA EN 10250.
- H. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.02 CEILING EXHAUST FANS

- A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resiliently mounted motor, gravity backdraft damper in discharge.
- B. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor and wall mounted switch.
- C. Grille: Aluminum with baked white enamel finish.
- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- E. Roof Curb: Provide with manufacturer's standard roof curb and curb cap appropriately sized for the airflow and static pressure requirements.
- F. Performance Ratings: As indicated on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

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

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Diffusers:
 - 1. Perforated ceiling diffusers.
- B. Rectangular ceiling diffusers.
- C. Registers/grilles:
 - 1. Wall-mounted grilles.
- D. Gravity ventilators.

1.02 REFERENCE STANDARDS

- A. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).
- B. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

PART 2 PRODUCTS

2.01 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square formed adjustable, backpan stamped, and core removable ceiling diffusers constructed to maintain 360 degree discharge air pattern with sectorizing baffles where indicated.
- B. Connections: Round.
- C. Frame: Provide surface mount and inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- D. Fabrication: Aluminum with baked enamel finish.
- E. Color: As selected by Engineer/Architect from manufacturer's standard range.

2.02 PERFORATED FACE CEILING DIFFUSERS

- A. Type: Perforated face with fully adjustable pattern and removable face.
- B. Frame: Provide surface mount and inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Steel with aluminum face and baked enamel finish.
- D. Color: As selected by Engineer/Architect from manufacturer's standard range.

2.03 WALL MOUNTED GRILLES

- A. Supply Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, horizontal face, double deflection.
- B. Return and Transfer Type: Streamlined fixed blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.

- C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- D. Fabrication: Aluminum frame and blades with factory clear lacquer finish.
- E. Color: To be selected by Engineer/Architect from manufacturer's standard range.

2.04 GRAVITY VENTILATORS

- A. Spun Aluminum Relief Gravity Ventilator:
 - 1. General:
 - a. Provide low silhouette configuration for relief applications with natural gravity or negative pressure system.
 - b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
 - c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
 - 2. Hood:
 - a. Material: Aluminum.
 - 3. Birdscreen:
 - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
 - 4. Options/Accessories:
 - a. Roof Curbs:
 - 1) Flat Roofs:
 - (a) Welded, straight side curb with flashing flange and wood nailer.
 - 2) Material: Aluminum.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.
- E. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
- F. Paint ductwork visible behind air outlets and inlets matte black, see Division 09.

3.02 PROTECTION

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

END OF SECTION

**SECTION 23 55 33
FUEL-FIRED UNIT HEATERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Gas fired unit heaters.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 54 - National Fuel Gas Code; 2024.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- F. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2024.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- B. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

1.06 WARRANTY

- A. See Division 01, for additional warranty requirements.
- B. Provide ten year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.01 GAS FIRED UNIT HEATERS

- A. Manufacturers:
 - 1. See schedules on drawings for listing of approved manufacturers.
- B. Unit Heaters: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories:
 - 1. Heating: Natural gas fired.
 - 2. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.

- C. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner.
- D. Supply Fan: Propeller type with direct drive, variable pitch motor pulley.
- E. Heat Exchanger: Aluminized steel welded construction.
- F. Gas Burner:
 - 1. Atmospheric type with adjustable combustion air supply.
 - 2. Gas valve provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
 - 3. Electronic pilot ignition, with electric spark igniter.
- G. Gas Burner Safety Controls:
 - 1. Thermocouple Sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 - 2. Vent Safety Shutoff Sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
- H. Operating Controls:
 - 1. Room Thermostat: Cycles burner to maintain room temperature setting.
- I. Requirements:
 - 1. Equipped with power venting.
- J. Performance:
 - 1. Refer to Gas Unit Heater Schedule on plans. Gas heating capacities are sea level ratings.

2.02 ROOM THERMOSTATS

- A. Room Thermostat: Adjustable, low voltage, to control burner operation, compressor and condenser fan and supply fan to maintain temperature setting. Include system selector switch (heat-off-cool) and fan control switch (auto-on).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that space is ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available.
- C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

- A. Install in accordance with NFPA 90A.
- B. Install gas fired units in accordance with NFPA 54 and applicable codes.
- C. Provide vent connections in accordance with NFPA 211. Refer to Section 23 51 00.
- D. Install unit heaters with vibration isolation. Refer to Section 23 05 48.

3.03 SCHEDULES

- A. See schedules on drawings for performance requirements.

END OF SECTION

**SECTION 23 74 33
DEDICATED OUTDOOR AIR UNITS**

PART 1 GENERAL

- 1.01 SECTION INCLUDES
 - A. Outdoor-mounted DOAS.
- 1.02 RELATED REQUIREMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- 1.03 REFERENCE STANDARDS
 - A. AHRI 270 (SI/I-P) - Sound Performance Rating of Outdoor Unitary Equipment; 2025.
 - B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
 - C. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
 - D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - E. NFPA 54 - National Fuel Gas Code; 2024.
 - F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - G. UL (DIR) - Online Certifications Directory; Current Edition.
 - H. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.
- 1.04 SUBMITTALS
 - A. Product Data: Provide data with dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
 - B. Shop Drawings: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
 - C. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- 1.05 QUALITY ASSURANCE
 - A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- 1.06 WARRANTY
 - A. Provide one year warranty on parts and labor.
 - B. Provide five year manufacturers warranty for compressor/condenser unit.
 - C. Provide ten year manufacturers warranty for heat exchanger.

PART 2 PRODUCTS

- 2.01 OUTDOOR-MOUNTED DOAS PERFORMANCE REQUIREMENTS
 - A. Performance Ratings: ASHRAE Std 90.1, EER and COP as applicable.
 - B. Regulatory Requirements: AHRI 270 (SI/I-P) rated, NFPA 70, and UL (DIR) listed.

- C. Supply Fan Section: Refer to schedules and drawings for information
 - 1. Fan Operation: Constant volume.
- D. Direct Gas Fired Heating Section: Refer to schedules and drawings for information
- E. Packaged DX Cooling Section: Refer to schedules and drawings for information
- F. Electrical: 208 VAC, 3-phase, 60 Hz, single point to factory-mounted fused disconnect switch internally wired into motors and compressors, and other powered components including system safeties.

2.02 OUTDOOR-MOUNTED DOAS

- A. Packaged Unit:
 - 1. Casing and Components:
 - a. Fabrication: AHRI 210/240 and UL 207 construction, ASHRAE Std 23 tested.
 - b. 18 gauge, 0.0478 inch steel panels reinforced with structural angles and channels to ensure rigidity.
 - c. Provide bolted access panels to access each sections from either side of unit.
 - d. Provide hinged door with lockable handle for serviceable sections.
 - e. Drain Pan: Galvanized steel with corrosion-resistant coating.
 - 2. Performance Ratings: ASHRAE Std 90.1, EER and COP as applicable.
 - 3. Regulatory Requirements: AHRI 270 (SI/I-P) rated, NFPA 70, and UL (DIR) listed.
 - 4. Insulation: Minimum 1/2 inch thick acoustic duct liner for lining cabinet interior.
 - 5. External Surface Finish: Heat resistant baked enamel.
 - 6. Outdoor Installation: Weatherproofed casing, with intake louver or hood.
 - 7. Outside Air Damper with Rain Hood and Screen:
- B. Filter Section:
 - 1. Filter: Removable, 4 inches thick combined MERV-8 and MERV-14.
 - 2. Monitoring: Provide gauge with loaded setpoint-adjustable signal flag or external tag. Provide loaded filter alarm switch wired into unit controls with illuminated indicator on local control panel face.
- C. Heating Section:
 - 1. Indirect Gas-Fired Furnace:
 - a. Insulation: Neoprene faced glass fiber insulation, 1 inch thick, on inlet components to burner profile plate.
 - b. Observation Port: On burner section for observing main and pilot flames.
 - c. Pilot: Electrically ignited by spark rod through high voltage ignition transformer.
 - d. Damper: Motorized with end switch to prove position before burner will fire.
- D. Cooling Section:
 - 1. Packaged DX Cooling:
 - a. Configuration: AHRI 520-rated, R-454B refrigerant system with hot gas bypass.
 - b. Evaporator Coil: Copper tube aluminum fin coil assembly with alternate row circuiting, and with galvanized drain pan and thermostatic expansion valve.
 - c. Compressor: Two inverter scroll, 3,600 rpm maximum resilience with positive lubrication, crankcase heater, high pressure control, low pressure control, motor overload protection, service valves and dryer.
 - d. Condenser Side: Aluminum fin and copper tube coil, direct drive axial fan resiliently mounted, galvanized fan guard. ECM condenser fans.
 - e. Operating and Safety Controls: Internally coordinated with main unit controls.
- E. Fan Section:
 - 1. Provide direct or plenum mounted variable-speed fan motors

2. Draw-through, forward-curved fan, constructed of corrosion-resistant, galvanized material and designed for efficient, quiet operation.
 3. Factory program for both soft start and constant flow output over static pressure range.
 4. Provide preinstalled neutral wire protection when required to support specified fan type.
 5. Motor to include thermal overload protection, quick disconnect plug, and permanently lubricated bearings.
 6. Variable Speed Control: Configure controller to maintain adjustable flow setpoint for modulating or speed-switched units.
- F. Unit Controls:
1. DDC:
 - a. Application Specific Controller; factory-provided.
 - b. Tested to monitor and handle sequencing functions and other operational modes using field-mounted thermostat and other sensors.
 - c. Coordination and Sequencing:
 - 1) Internal Devices: Include compressors, blower, sensors, switches, valves, safeties, other components.
 - 2) Field-Installed Devices: Solenoid valves, thermostat, internal and remote contacts, and other devices required for operation.
 - 3) Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high pressure, refrigerant low pressure, loss-of-charge, refrigerant freeze protection, and freezestat.
 2. Thermostat:
 - a. Field mounted and wired, tied into prewired control-interface terminals.
 - b. Smart Thermostat:
 - 1) BAS, SCADA, or Integrated Automation linked programmable thermostat.
 - c. Programmable Thermostat:
 - 1) Electro-mechanical type with key- or pushbutton-operated display.
 - 2) Programmable occupied/unoccupied weekly and holiday schedule.
 - d. Nonprogrammable Thermostat:
 - 1) Electro-mechanical type with key- or pushbutton-operated display.
 - 2) User-configurable, precoded options aligned with equipment functions.
 3. Airflow Meter:
 - a. Include integral airflow meter station or probe for ventilation airflow in cfm as indicated on drawings.
 - b. Mount monitor gauge parallel to airflow meter on unit exterior and make casing connection watertight.
 4. Local Control Panel: Interface to include on-off-auto switch, summer-winter switch, heat-off-cool switch, indicating lights for supply fan, pilot operation, burner operation, lockout indication, and clogged filter indication.
 5. Interlocked Functions:
 - a. Unit to start when kitchen exhaust fan is running.
 - b. Low and High Limit Controls: Maintain supply air temperature between set points and shut fan down if temperatures are exceeded. Include manual reset switch.
 - c. Burner Safety Controls:
 - 1) Sense correct airflow before energizing pilot and sense pilot ignition before activating main gas valve.
 - 2) Burner to operate when flow switch located in exhaust duct proves flow. Exhaust fan speed control with inlet damper and burner profile damper to provide dual volume air capacity.

- 3) Purge Period Timer: Automatically delays burner ignition and bypass low limit control.
- G. Electrical: 208 VAC, 3-phase, 60 Hz, single point to factory-mounted nonfused disconnect switch internally wired into motors and compressors, and other powered components including system safeties.
- H. Furnish dedicated outdoor air unit and associated components and accessories produced by a single manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Follow NFPA 54 guidelines to provide natural gas system connection; see Section 23 11 23.
- C. Install unit on vibration isolator pad or roof curb; see Section 23 05 48.
- D. Provide flexible duct connections on inlet and outlet from unit; see Section 23 33 00.
- E. Connect drain pan outlet to nearest building drain system piping.
- F. Adjusting: Use plenum static pressure readings against manufacturer calibration chart to adjust primary airflow as other measuring methods will not work.
- G. Coordinate BMS linking between unit controller(s) and remote front end interface.

3.02 MAINTENANCE

- A. Provide service and maintenance of units for one year from Date of Substantial Completion.

END OF SECTION

SECTION 23 81 26.13
SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air-source heat pumps.
- B. Air cooled condensing units.
- C. Indoor air handling (fan and coil) units for ductless systems.
- D. Controls.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 270 (SI/I-P) - Sound Performance Rating of Outdoor Unitary Equipment; 2025.
- C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Errata (2025).
- E. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- I. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- B. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- C. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

1.06 WARRANTY

- A. Provide ten year manufacturers warranty for compressors and parts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. See schedules on drawings for listing of approved manufacturers.

2.02 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator.
 - 2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Schedule for all requirements.

2.03 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
 - 1. Location: High-wall.
 - 2. Cabinet: Galvanized steel.
 - 3. Fan: Line-flow fan direct driven by a single motor.
 - 4. Filter return air with washable, antioxidant pre-filter and a pleated anti-allergy enzyme filter.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
 - 2. Manufacturer: System manufacturer.

2.04 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
 - 1. Comply with AHRI 210/240.
 - 2. Refrigerant: R-454B or R32.
 - 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 - 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.
- B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
- C. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
 - 1. Provide thermostatic expansion valves.
- D. Operating Controls:
 - 1. Control by room thermostat to maintain room temperature setting.
- E. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.

2.05 ACCESSORY EQUIPMENT

- A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
 - 1. System selector switch (heat-off-cool) and fan control switch (auto-on).
 - 2. Automatic switching from heating to cooling.

3. Preferential rate control to minimize overshoot and deviation from setpoint.
4. Instant override of setpoint for continuous or timed period from one hour to 31 days.
5. Short cycle protection.
6. Programming based on weekdays, Saturday and Sunday.
7. Thermostat Display:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

SECTION 23 81 29
VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air-source outdoor units.
- B. Refrigerant piping.
- C. Indoor units.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 1230 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment; 2021.
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Errata (2025).
- E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2024, with Addendum (2025).
- F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ITS (DIR) - Directory of Listed Products; Current Edition.
- H. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in Contract Documents:
 - 1. Outdoor Units:
 - a. Refrigerant Type and Size of Charge.
 - b. Output and Input Cooling Capacity: Btu/h.
 - c. Output and Input Heating Capacity: Btu/h.
 - d. Operating Temperature Range, Cooling and Heating.
 - e. Fan Capacity: Flow in cfm with respective fan curves.
 - f. External Static Pressure (ESP): In-wc.
 - g. Sound Pressure Level: dB(A).
 - h. Electrical Data: Complete including motor size.
 - i. Maximum number of indoor units that can be served.
 - j. Maximum refrigerant piping run from outdoor unit to indoor unit(s).

- k. Maximum height difference between outdoor unit to Indoor unit(s), both above and below.
 - 2. Indoor Units:
 - a. Output and Input Cooling Capacity: Btu/h.
 - b. Output and Input Heating Capacity: Btu/h.
 - c. Fan Capacity: Flow in cfm with respective fan curves.
 - d. External Static Pressure (ESP): In-wc.
 - e. Electrical Data: Complete including motor size.
 - B. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
 - 1. Detailed piping diagrams, with branch balancing devices.
 - 2. Condensate piping routing, size, and pump connections.
 - 3. Detailed power wiring diagrams.
 - 4. Locations of required access through fixed construction.
 - 5. Drawings required by manufacturer.
- 1.05 QUALITY ASSURANCE
 - A. Manufacturer Qualifications:
 - 1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.
 - B. Installer Qualifications: Trained and approved by manufacturer of equipment.
- 1.06 DELIVERY, STORAGE AND HANDLING
 - A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.
- 1.07 WARRANTY
 - A. Parts and Compressors: Provide manufacturer's extended warranty for 10 years from date of installation.

PART 2 PRODUCTS

- 2.01 VARIABLE REFRIGERANT FLOW SYSTEM
 - A. Minimum System Requirements:
 - 1. System Testing, Capacity Rating, and Performance:
 - a. AHRI 1230 when cooling capacity is equal or greater than 65,000 Btu/h.
 - b. AHRI 210/240 when cooling capacity is below 65,000 Btu/h.
 - 2. Safety Certification: Bear UL 1995 tested and ITS (DIR) listed certification label.
 - 3. Outdoor Units: Furnish installation and surface support hardware products in accordance with ASCE 7 for wind restraint.
 - 4. Indoor Air Quality or IAQ:
 - a. Provide filtered outdoor air ventilation as indicated on drawings using the decoupled method using separate DOAS; see Section 23 74 33.
 - 5. Cooling Mode Interior Performance:
 - a. Daytime Setpoint: 68 degrees F, plus or minus 2 degrees F.
 - b. Setpoint Range: 57 degrees F to 77 degrees F.
 - c. Night Setback: 78 degrees F.
 - d. Interior Relative Humidity: 40 percent, maximum.
 - 6. Heating Mode Interior Performance:

- a. Setpoint: 68 degrees F, plus or minus 2 degrees F.
 - b. Setpoint Range: 59 to 80 degrees F.
 - c. Night Setback: 60 degrees F.
 - d. Minimum Interior Relative Humidity: 10 percent RH.
- B. System Design and Installation Considerations:
- 1. Conditioned spaces and zones are indicated on drawings.
 - 2. Outside unit locations are indicated on drawings.
 - 3. Indoor unit locations are indicated on drawings.
 - 4. Required equipment unit capacities are indicated on drawings.
 - 5. Refrigerant piping sizes are not indicated on drawings.
 - 6. Condensate piping to nearest drain is indicated on drawings.
 - 7. Provide calculations showing ASHRAE Std 15 guideline compliance.

2.02 AIR-SOURCE OUTDOOR UNITS

- A. Heat Pump Type:
- 1. DX refrigeration unit piped to one or more compatible indoor units either directly or indirectly through one or more intermediate refrigeration branch units.
- B. Unit Cabinet:
- 1. Designed to allow side-by-side installation with minimum spacing and vibration isolation.
 - 2. Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
 - 3. Sound Pressure Level: 55 dB measured at 3 feet from front of unit.
- C. Heat Sink Side:
- 1. Condenser Fans:
 - a. Minimum External Static Pressure: Factory set at 0.12 in-wc.
 - b. Fan Type: Horizontal discharging, direct-driven propeller type with variable speed operation using DC-controlled ECM motors mechanically connected using permanently lubricated bearings having whole assembly protected with fan guards.
 - 2. Condenser Coils:
 - a. Nonferrous construction with lanced or corrugated plate fins on copper tubing. Protected with integral guard..
- D. Refrigeration Side:
- 1. Factory assembled and wired with instrumentation, switches, and controller(s) to handle unit specifics with direct coordination of remote controller(s) from indoor unit(s).
 - 2. Refrigeration Circuit: hermetic, inverter driven compressors, fans, condenser heat sink coil, expansion valves, solenoid valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, and refrigerant regulator.
 - 3. Variable Volume Control: Modulate compressed refrigerant capacity automatically to maintain constant suction and condensing pressures under varying refrigerant volume required to handle remote loads. Include defrost control.
 - 4. Provide refrigerant subcooling to ensure the liquid refrigerant does not flash when supplying to use indoor units.
 - 5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle, oil return, or defrost is not permitted due to potential reduction in space temperature.
 - 6. Power Failure Mode: Automatically restarts operation after power failure without loss of programmed settings.

7. Safety Devices: High pressure sensor with cut-out switch, low pressure sensor with cut-out switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and antirecycling timers.
 8. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.
- E. Local Controls:
1. Include factory-wired instruments, sensors, switches, and safeties for unit control.
 2. Configured to coordinate internal unit operation with remote indoor units and with built-in capacity to coordinate other manifolded outdoor units and remote refrigerant branch unit(s).
 3. Include screen and button interface to setup operating schedules, setpoints, alarms, and remote unit setpoint coordination. Also used for system troubleshooting.
 4. Self diagnostic, auto-check functions to detect malfunctions and display the type and location.
- F. Power:
1. Electrical Requirement: 208 to 230 VAC, 3-phase, 60 Hz.
 2. Outdoor Mounted: Provide fused NEMA EN 10250 Type 4X disconnect switch.

2.03 REFRIGERANT PIPING

- A. Two-Pipe Run: Provide low-pressure vapor and high-pressure vapor gas pipes for each indoor unit selected for seasonal heating or cooling service.
- B. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.

2.04 INDOOR UNITS

- A. Ceiling-Concealed Ducted Indoor Units:
1. Type: Ducted unit with DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
 2. Ducted horizontal discharge and side or back-end return; galvanized steel cabinet.
 3. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.
 4. Return Air Filter: High efficiency, MERV 8.
 5. Sound Pressure: Measured at low speed at 5 feet below unit.
 6. Provide external static pressure switch adjustable for high efficiency filter operation
 7. Condensate Pump: External, with lift of 9 inches, minimum.
 8. Switchbox accessible from side or bottom.
- B. Wall Mounted, Indoor Units:
1. DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
 2. Variable or three-speed ECM cross-flow fan with automatic airflow adjustment; external static pressure selectable during commissioning.
 3. Return Air Filter: Manufacturer's standard.
 4. Provide exposed unit casing with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.
 5. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaults to same angle as previous operation.
 6. Sound Pressure Range: Measured at low speed at 3.3 feet below and away from unit.
 7. Condensate Pump: External, concealed.
 8. Condensate Drain Connection: Back, with piping concealed in wall.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.
- B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.
- C. Notify Engineer/Architect if conditions for installation are unsatisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install refrigerant piping in accordance with equipment manufacturer's instructions.
- C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).
- D. Coordinate with installers of systems and equipment connecting to this system.
- E. Refrigerant Piping: See Section 23 23 00 with Section 23 07 19 for insulation, and Section 23 05 29 for hangers and supports unless following specific manufacturer recommendations.
- F. Connect indoor units to condensate piping.

3.03 FIELD QUALITY CONTROL

- A. See Division 01 for additional requirements.
- B. Provide manufacturer's field representative to inspect installation prior to startup.

3.04 SYSTEM STARTUP

- A. Provide manufacturer's field representative to perform system startup.
- B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
- C. Adjust equipment for proper operation within manufacturer's published tolerances.

3.05 CLEANING

- A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.06 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.

3.07 PROTECTION

- A. Protect installed components from subsequent construction operations.
- B. Replace exposed components broken or otherwise damaged beyond repair.

END OF SECTION

SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

1.02 RELATED REQUIREMENTS

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

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Engineer/Architect before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical and Auxiliary Systems: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling affected systems.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.
- E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner before partially or completely disabling system.
 - 2. Notify local fire service.
 - 3. Make notifications at least 24 hours in advance.
 - 4. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner at least 24 hours before partially or completely disabling system.

2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
3. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 2. PCB- and DEHP-containing lighting ballasts.
 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Oxide inhibiting compound.
- G. Wire pulling lubricant.
- H. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07, Firestopping.
- C. Section 26 05 05 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2021).
- F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation; 2018 (Reapproved 2023).
- G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2024.
- H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- J. NECA 104 - Standard for Installing Aluminum Building Wire and Cable; 2012.

- K. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
- L. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- M. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- P. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- Q. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
- R. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- S. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- T. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- U. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- V. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer/Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - b. Where concealed in hollow stud walls and above accessible ceilings for branch circuits up to 20 A.
 - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
 - 2. In addition to other applicable restrictions, may not be used:
 - a. Where not approved for use by the authority having jurisdiction.
 - b. Where exposed to view.
 - c. Where exposed.
 - d. For damp, wet, or corrosive locations.
- H. Manufactured wiring systems are not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- H. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
- I. Conductor Material:
 - 1. Provide copper conductors except where aluminum conductors are specifically indicated on the Drawings. Substitution of aluminum conductors for copper is not permitted. Conductor sizes indicated are based on copper unless specifically indicated as aluminum.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
 - 4. Aluminum Conductors (only where specifically indicated): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.
- J. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:

- 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
2. Control Circuits: 14 AWG.
- K. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- L. Conductor Color Coding:
 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 3. Color Code:
 - a. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - b. Equipment Ground, All Systems: Green.
 - c. Travelers for 3-Way and 4-Way Switching: Pink.
 - d. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
 - d. Service Wire Co: www.servewire.com/#sle.
 - e. Southwire Company: www.southwire.com/#sle.
 2. Aluminum Building Wire (only where specifically indicated):
 - a. Encore Wire Corporation: www.encorewire.com/#sle.
 - b. Southwire Company: www.southwire.com/#sle.
 - c. Stabiloy, a brand of General Cable Technologies Corporation; _____: www.stabiloy.com/#sle.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 1. Copper Building Wire: Type THHN/THWN-2.

- a. Installed Underground: Type XHHW-2.
- 2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.04 METAL-CLAD CABLE

- A. Manufacturers:
 - 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - 3. Service Wire Co: www.servicewire.com/#sle.
 - 4. Southwire Company: www.southwire.com/#sle.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN/THWN-2.
- F. Provide dedicated neutral conductor for each phase conductor.
- G. Grounding: Full-size integral equipment grounding conductor.
- H. Armor: Aluminum or steel, interlocked tape.

2.05 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
 - 3. Connectors for Aluminum Conductors: Use compression connectors.
 - a. Pin-style connectors are allowed for aluminum conductors only where necessary to accommodate connections to existing equipment terminations that are only rated for use with copper conductors, or where the existing terminations are not sized properly for the required aluminum conductor size.
- D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

6. Aluminum Conductors: Use compression connectors for all connections.
 7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 8. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
 - F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
 - G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 - H. Mechanical Connectors: Provide bolted type or set-screw type.
 - I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.06 ACCESSORIES

- A. Electrical Tape:
 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- D. Wire Pulling Lubricant:
 1. Listed and labeled as complying with UL 267.
 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 3. Suitable for use at installation temperature.
- E. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:
 - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 - 2. When circuit destination is indicated without specific routing, determine exact routing required.
 - 3. Arrange circuiting to minimize splices.
 - 4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 - 5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 - 6. Circuiting Adjustments: Unless otherwise indicated, when 20A single-phase branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway.
Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 - 7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install aluminum conductors in accordance with NECA 104.
- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent

support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- I. Terminate cables using suitable fittings.
1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
 - c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.
- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- N. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.

- b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 - 3. Wet Locations: Use heat shrink tubing.
 - P. Insulate ends of spare conductors using vinyl insulating electrical tape.
 - Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
 - R. Identify conductors and cables in accordance with Section 26 05 53.
 - S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07 firestopping section
 - T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- 3.04 FIELD QUALITY CONTROL
- A. See Division 01 Quality Requirements for additional requirements.
 - B. Inspect and test in accordance with NETA ATS, except Section 4.
 - C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is only required for conductors larger than 6 AWG. The resistance test for parallel conductors listed as optional is not required.
 - D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2025.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. See Division 01 for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer/Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method or alternate test described in IEEE 81.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 4. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 6. Ground Bar: Ground bar, separate from service equipment enclosure, is permitted for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 4 by 24 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- G. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.
 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 8. Provide bonding for interior metal air ducts.
- J. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
 2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.
- C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 4. Manufacturers - Mechanical and Compression Connectors:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
 - b. Harger Lightning & Grounding; _____: www.harger.com/#sle.
 - c. nVent ERICO; _____: www.nvent.com/#sle.
 - d. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC; _____: www.burndy.com/#sle.

- b. nVent ERICO; Cadweld: www.nvent.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC;
www.thermoweld.com/#sle.
- D. Ground Bars:
 - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 - 2. Size: As indicated.
 - 3. Holes for Connections: As indicated or as required for connections to be made.
 - 4. Manufacturers:
 - a. Harger Lightning & Grounding; www.harger.com/#sle.
 - b. nVent ERICO; www.nvent.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC;
www.thermoweld.com/#sle.
- E. Ground Rod Electrodes:
 - 1. Comply with NEMA GR 1.
 - 2. Material: Copper-bonded (copper-clad) steel.
 - 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
 - 4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
 - 5. Manufacturers:
 - a. Galvan Industries, Inc; www.galvanelectrical.com/#sle.
 - b. Harger Lightning & Grounding; www.harger.com/#sle.
 - c. nVent ERICO; www.nvent.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
 - 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.

- 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
 - E. Identify grounding and bonding system components in accordance with Section 26 05 53.
- 3.03 FIELD QUALITY CONTROL
- A. See Division 01 Quality Requirements for additional requirements.
 - B. Inspect and test in accordance with NETA ATS except Section 4.
 - C. Perform inspections and tests listed in NETA ATS, Section 7.13.
 - D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 03 Cast-in-Place Concrete: Concrete equipment pads.
- C. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- D. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- E. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- F. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Engineer/Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Division 03 Cast-in-Place Concrete.

1.05 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of 25 percent. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 3. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
- D. Metal Channel/Strut Framing Systems:
 - 1. Manufacturers:

- a. ABB: www.electrification.us.abb.com/#sle.
 - b. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
 - c. Eaton Corporation: www.eaton.com/#sle.
- 2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
- 3. Comply with MFMA-4.
- 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel or zinc-plated steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
- 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
- 6. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
 - 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2-inch diameter.
 - b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
 - c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
 - e. Outlet Boxes: 1/4-inch diameter.
 - f. Luminaires: 1/4-inch diameter.
- F. Anchors and Fasteners:
 - 1. Manufacturers - Mechanical Anchors:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - 2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - 3. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 6. Hollow Masonry: Use toggle bolts.
 - 7. Hollow Stud Walls: Use toggle bolts.
 - 8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 9. Sheet Metal: Use sheet metal screws.
 - 10. Wood: Use wood screws.
 - 11. Plastic and lead anchors are not permitted.
 - 12. Powder-actuated fasteners with lock nuts and washers are permitted only as follows:
 - a. 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.
 - b. Use only threaded studs; do not use pins.
 - 13. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.

- c. Channel Material: Use galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Engineer/Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Engineer/Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 - 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad 4 inches in height; see Division 03 Cast-in-Place Concrete.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Conduit Support and Attachment: See Section 26 05 33.13 for additional requirements.
- I. Box Support and Attachment: See Section 26 05 33.16 for additional requirements.
- J. Interior Luminaire Support and Attachment: See Section 26 51 00 for additional requirements.
- K. Exterior Luminaire Support and Attachment: See Section 26 56 00 for additional requirements.
- L. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- M. Secure fasteners in accordance with manufacturer's recommended torque settings.
- N. Remove temporary supports.
- O. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. See Division 01 Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.

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

END OF SECTION

**SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Galvanized steel intermediate metal conduit (IMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Galvanized steel electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07, Firestopping.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 33.16 - Boxes for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2025.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2025.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2025.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- L. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- M. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- N. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- P. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

- Q. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
- R. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
 - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
 - 5. Notify Engineer/Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 SUBMITTALS

- A. See Division 01 for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 - 3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
 - 4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel intermediate metal conduit (IMC) where emerging from underground.

5. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel intermediate metal conduit (IMC) elbows for bends.
 6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use factory-applied corrosion protection coating acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
- D. Embedded Within Concrete:
 1. Within Slab on Grade: Not permitted.
 2. Within Slab Above Ground: Not permitted.
 - E. Concealed Within Masonry Walls: Use galvanized steel electrical metallic tubing (EMT).
 - F. Concealed Within Hollow Stud Walls: Use galvanized steel electrical metallic tubing (EMT).
 - G. Concealed Above Accessible Ceilings: Use galvanized steel electrical metallic tubing (EMT).
 - H. Interior, Damp or Wet Locations: Use galvanized steel electrical metallic tubing (EMT).
 - I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel electrical metallic tubing (EMT).
 - J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel intermediate metal conduit (IMC).
 - K. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel intermediate metal conduit (IMC).
 - L. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
 1. Exterior locations subject to severe physical damage include, but are not limited to:
 - a. Where exposed to vehicular traffic below 20 feet.
 - M. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 1. Maximum Length: 6 feet.
 - N. Flexible Connections to Vibrating Equipment:
 1. Dry Locations: Use flexible metal conduit (FMC).
 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 3. Maximum Length: 3 feet unless otherwise indicated.
 4. Minimum Length: 2 feet unless otherwise indicated.
 5. Vibrating equipment includes, but is not limited to:
 - a. Motors.
 - b. HVAC equipment.
 - O. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC).

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 1. Branch Circuits: 3/4-inch trade size.
 2. Branch Circuit Homeruns: 3/4-inch trade size.
 3. Control Circuits: 1/2-inch trade size.
 4. Flexible Connections to Luminaires: 3/8-inch trade size.

5. Underground, Interior: 3/4-inch trade size.
 6. Underground, Exterior: 1-inch trade size.
- E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- 2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)
- A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 3. Robroy Industries.
 4. Rymco USA: www.rymcousa.com/#sle.
 5. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 6. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 2. Material: Use steel or malleable iron.
 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.
- 2.04 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)
- A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 3. Rymco USA: www.rymcousa.com/#sle.
 4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
 2. Material: Use steel or malleable iron.
 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.
- 2.05 FLEXIBLE METAL CONDUIT (FMC)
- A. Manufacturers:
1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
 2. Anamet Electrical.
 3. Electri-Flex Company: www.electriflex.com/#sle.
 4. International Metal Hose: www.metalhose.com/#sle.
 5. Southwire Company.
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
 - 2. Anamet Electrical.
 - 3. Electri-Flex Company: www.electriflex.com/#sle.
 - 4. International Metal Hose: www.metalhose.com/#sle.
 - 5. Southwire Company.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.

2.07 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use compression/gland type.
 - a. Do not use indenter type connectors and couplings.
 - b. Do not use set-screw type connectors and couplings.
 - 4. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. ABB; Carlon: www.carlon.com/#sle.
 - 2. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 3. Cantex Inc: www.cantexinc.com/#sle.
 - 4. Heritage Plastics, a division of Atkore International: www.heritageplastics.com/#sle.
 - 5. JM Eagle: www.jmeagle.com/#sle.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- D. Foam Conduit Sealant:
 - 1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
 - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 3. Rated to hold minimum of 10 ft water head pressure.
- E. Sealing Systems for Concrete Penetrations:
 - 1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
 - 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.
- E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- F. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - d. Finished areas such as classrooms and offices without hollow stud walls as indicated on architectural drawings. Paint to match surrounding finishes.
 - 5. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 - 6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 7. Arrange conduit to maintain adequate headroom, clearances, and access.

8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 9. Arrange conduit to provide no more than 150 feet between pull points.
 10. Route conduits above water and drain piping where possible.
 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 14. Group parallel conduits in same area on common rack.
- G. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
 9. Use of wire for support of conduits is not permitted.
 10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- H. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 8. Secure joints and connections to provide mechanical strength and electrical continuity.
- I. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
 8. Install firestopping to preserve fire resistance rating of partitions and other elements; see appropriate Division 07 section where firestopping is specified.
- J. Underground Installation:
1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Comply with NFPA 70 Article 300 requirements.
 2. Provide underground warning tape along entire conduit length; see Section 26 05 53.
- K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where conduits are subject to earth movement by settlement or frost.
- L. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits enter building from outside.
 - b. Where service conduits enter building from underground distribution system.
 - c. Where conduits enter building from underground.
 - d. Where conduits may transport moisture to contact live parts.
 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- M. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- N. Provide grounding and bonding; see Section 26 05 26.

3.03 FIELD QUALITY CONTROL

- A. See Division 01 Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 03, Cast-in-Place Concrete.
- C. Division 08, Access Doors and Panels: Panels for maintaining access to concealed boxes.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 33.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use nonmetallic boxes where exposed rigid PVC conduit is used.
4. Use suitable concrete type boxes where flush-mounted in concrete.
5. Use suitable masonry type boxes where flush-mounted in masonry walls.
6. Use raised covers suitable for the type of wall construction and device configuration where required.
7. Use shallow boxes where required by the type of wall construction.
8. Do not use "through-wall" boxes designed for access from both sides of wall.
9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.

10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
11. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
12. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
13. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
14. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
15. Wall Plates: Comply with Section 26 27 26.
16. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - b. Hubbell Incorporated; Bell Products; _____: www.hubbell-rtb.com/#sle.
 - c. Hubbell Incorporated; RACO Products; _____: www.hubbell-rtb.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co; _____: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Division 08 Access Doors and Panels as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
 - 9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
 - 10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- I. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

- 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 - 4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
 - J. Install boxes plumb and level.
 - K. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
 - L. Floor-Mounted Cabinets: Mount on properly sized 4 inch high concrete pad constructed in accordance with Division 03 Cast-in-Place Concrete.
 - M. Install boxes as required to preserve insulation integrity.
 - N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
 - O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07 Firestopping.
 - P. Close unused box openings.
 - Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
 - R. Provide grounding and bonding in accordance with Section 26 05 26.
 - S. Identify boxes in accordance with Section 26 05 53.
- 3.03 CLEANING
- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.
- 3.04 PROTECTION
- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- C. Section 26 27 26 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components. Use color code indicated in labeling details on Drawings.
 - 2. Include equipment name/designation shown on Drawings for all equipment and the following additional information:
 - a. Panelboards:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces.
 - 5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - 6) Label each circuit breaker with manufacturer provided circuit number following NEMA standard numbering.
 - b. Enclosed switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 3. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 - 4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 - 5. Use identification label at each fused switch to identify required NEMA fuse class and size.
 - 6. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".

7. Use floor marking tape or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction. Coordinate marking method and color with Owner.
 8. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 9. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
 - c. Service Equipment: Include the following information in accordance with NFPA 70.
 - 1) Nominal system voltage.
 - 2) Available fault current.
 - 3) Clearing time of service overcurrent protective device(s).
 - 4) Date label applied.
 10. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection for feeders.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 5. Use underground warning tape to identify direct buried cables.
- D. Identification for Raceways:
1. Use voltage markers or identification labels to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
 2. Use factory-painted conduits to identify specified systems for accessible conduits.
 - a. Maximum Intervals: 20 feet.
 - b. Color Code:
 - 1) Refer to labeling details on Drawings.

- 2) Fire Alarm System: Red.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
4. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
5. Use underground warning tape to identify underground raceways.
6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.
- E. Identification for Boxes:
 1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers or color coded boxes to identify specified systems.
 - a. Color-Coded Boxes: Field-painted in accordance with Division 09 Painting Sections per the same color code used for raceways.
 - b. For exposed boxes in public areas, do not color code.
 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.
- F. Identification for Devices:
 1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
 2. Use identification label to identify fire alarm system devices.
 - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
 3. Use identification label to identify serving branch circuit for all wiring devices.
 4. Use identification label to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic nameplates suitable for exterior use.
 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/8 inch; engraved text.
 3. Attachment: Two-part epoxy, non-corrosive machine screws, or rivets.
 - a. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
 1. Manufacturers:
 - a. Brady Corporation; _____: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
 1. Minimum Size: 1.5 inches by 4 inches.

2. Legend:
 - a. Refer to labeling details on Drawings for additional requirements.
 - b. Equipment designation or other approved description.
 - c. Other information as indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Other Information: 1/4 inch.
 - c. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
 5. Color:
 - a. Normal Power System: White text on black background.
 - b. Refer to labeling details on Drawings for additional requirements.
- D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/4 inch.
 5. Color: Black text on white background unless otherwise indicated.
- E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.

2.03 WIRE AND CABLE MARKERS

- A. Manufacturers:
1. Brady Corporation; _____: www.bradyid.com/#sle.
 2. HellermannTyton; _____: www.hellermannntyton.com/#sle.
 3. Panduit Corp: www.panduit.com/#sle.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, or heat-shrink sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
1. Do not use handwritten text.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Manufacturers:
1. Brady Corporation; _____: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.

3. Seton Identification Products; _____: www.seton.com/#sle.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. Minimum Size:
 1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
 1. Markers for Voltage Identification: Highest voltage present.
 2. Markers for System Identification:
- F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 1. Brady Corporation; _____: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Seton Identification Products; _____: www.seton.com/#sle.
- B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- C. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- D. Legend: Type of service, continuously repeated over full length of tape.
- E. Color:
 1. Tape for Buried Power Lines: Black text on red background.
 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 FLOOR MARKING TAPE

- A. Manufacturers:
 1. Brady Corporation; _____: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Insite Solutions, LLC; _____: www.stop-painting.com/#sle.
 4. Seton Identification Products; _____: www.seton.com/#sle.
- B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

- A. Manufacturers:
 1. Brimar Industries, Inc: www.brimar.com/#sle.
 2. Clarion Safety Systems, LLC; _____: www.clarionsafety.com/#sle.
 3. Insite Solutions, LLC; _____: www.stop-painting.com/#sle.
 4. Seton Identification Products; _____: www.seton.com/#sle.
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:
 1. Materials:

- a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum or rigid plastic signs.
- 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
- 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- D. Warning Labels:
 - 1. Materials: Use factory pre-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - a. Do not use labels designed to be completed using handwritten text.
 - 2. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Enclosure front.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.
 - 8. Boxes: Outside face of cover.
 - 9. Conductors and Cables: Legible from the point of access.
 - 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using rivets, epoxy cement, or stainless steel machine screws and to interior surfaces using epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 6 to 8 below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

**SECTION 26 05 83
WIRING CONNECTIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 27 26 - Wiring Devices.
- F. Section 26 28 16.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 28 16.16.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 33.13.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 33.16.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Time switches.
- C. Outdoor photo controls.
- D. Lighting contactors.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
 - 1. Includes finish requirements for wall controls specified in this section.
- F. Section 26 51 00 - Interior Lighting.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- F. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.
- G. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- J. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- K. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- M. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
- N. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
 - 2. Coordinate placement of wall switch occupancy sensors with installed door swings.
 - 3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.
 - 4. Coordinate lighting control device product selections with luminaire characteristics; see Section 26 51 00 and lighting fixture schedule.
 - 5. Notify Engineer/Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- B. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- C. Operation and Maintenance Data: Include detailed information on device programming and setup.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Division 01 Product Requirements for additional provisions.
 - 2. Indicating Lights: Two of each different type.
- E. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Maintain at project site one copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- D. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

1.09 WARRANTY

- A. See appropriate Division 01 section where closeout requirements are specified for additional warranty requirements.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for purpose intended.
- B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. Hubbell Incorporated: www.hubbell.com/#sle.
 - 3. Legrand North America, Inc: www.legrand.us/#sle.
 - 4. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 5. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.
- B. General Requirements:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.
 - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during adjustable turn-off delay time interval.
 - 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 - 6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 - 7. Sensitivity: Field adjustable.
 - 8. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 - 9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
 - 10. Load Rating for Line Voltage Occupancy Sensors: As required to control load indicated on drawings.
- C. Wall Switch Occupancy Sensors:
 - 1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control load indicated on drawings, provide line voltage units with self-contained relay.

- c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
 - d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.
 - f. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
 - g. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.
 - 2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within area of 900 square feet.
- D. Wall Dimmer Occupancy Sensors:
- 1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.
 - b. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.
 - c. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
 - d. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
- E. Ceiling Mounted Occupancy Sensors:
- 1. General Requirements:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Finish: White unless otherwise indicated.
 - 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Extended Range Sensors: Capable of detecting motion within area of 1,200 square feet at mounting height of 9 feet, with field of view of 360 degrees.
- F. Directional Occupancy Sensors:
- 1. General Requirements:
 - a. Description: Occupancy sensors designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Finish: White unless otherwise indicated.
 - 2. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within distance of 40 feet at mounting height of 10 feet.

- G. Power Packs for Low-Voltage Occupancy Sensors:
 - 1. Description: Plenum rated, self-contained low-voltage class 2 transformer and relay compatible with specified low-voltage occupancy sensors for switching of line-voltage loads.
 - 2. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.
 - 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 - 4. Load Rating: As required to control load indicated on drawings.

2.03 TIME SWITCHES

- A. Manufacturers:
 - 1. Intermatic, Inc: www.intermatic.com/#sle.
 - 2. NSI Industries LLC: www.nsiindustries.com/#sle.
 - 3. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.
- B. Digital Electronic Time Switches:
 - 1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
 - 2. Program Capability:
 - a. Astronomic Time Switches: One, two, or four channel as indicated, capable of different schedule for each day of week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
 - 3. Schedule Capacity: Not less than 16 programmable on/off operations.
 - 4. Provide automatic daylight savings time and leap year compensation.
 - 5. Provide power outage backup to retain programming and maintain clock.
 - 6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 - 7. Provide remote photocell input with light level adjustment.
 - 8. Input Supply Voltage: As indicated on the drawings.
 - 9. Output Switch Configuration: As required to control load indicated on drawings.
 - 10. Output Switch Contact Ratings: As required to control load indicated on drawings.
 - 11. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:
 - a. Indoor clean, dry locations: Type 1.
 - b. Outdoor locations: Type 3R.

2.04 OUTDOOR PHOTO CONTROLS

- A. Manufacturers:
 - 1. Intermatic, Inc: www.intermatic.com/#sle.
 - 2. NSI Industries LLC: www.nsiindustries.com/#sle.
 - 3. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.
- B. Stem-Mounted Outdoor Photo Controls:
 - 1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
 - 2. Housing: Weatherproof, impact resistant polycarbonate.
 - 3. Photo Sensor: Cadmium sulfide.
 - 4. Provide external sliding shield for field adjustment of light level activation.
 - 5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
 - 6. Voltage: As required to control load indicated on drawings.

7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control load indicated on drawings.
9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

2.05 LIGHTING CONTACTORS

- A. Manufacturers:
 1. ABB: www.electrification.us.abb.com/#sle.
 2. Eaton Corporation: www.eaton.com/#sle.
 3. Rockwell Automation Inc: www.rockwellautomation.com/#sle.
 4. Schneider Electric: www.se.com/#sle.
 5. Siemens Industry, Inc: www.new.siemens.com/#sle.
- B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on drawings.
- C. Short Circuit Current Rating:
 1. Provide contactors with listed short circuit current rating not less than available fault current at installed location as indicated on the drawings.
- D. Enclosures:
 1. Comply with NEMA IA 10030.
 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - b. Outdoor Locations: Type 3R or Type 4.
 3. Finish: Manufacturer's standard unless otherwise indicated.

2.06 ACCESSORIES

- A. Auxiliary Contacts:
 1. Comply with NEMA IA 10039.
 2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus two spare contacts of type indicated, minimum.
- B. Pilot Devices:
 1. Comply with NEMA IA 10039; heavy-duty type.
 2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
 3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
 4. Indicating Lights: Push-to-test type unless otherwise indicated.
 5. Provide LED lamp source for indicating lights and illuminated devices.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.

- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 26 05 33.16.
 - 1. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
 - 2. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Engineer/Architect to obtain direction prior to proceeding with work.
- C. Maintain separation of remote-control, signaling, and power-limited circuits.
 - 1. See manufacturer instructions and Section 26 05 19 for control wiring conductors, wiring methods, and identification requirements.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Install lighting control devices plumb and level, and held securely in place.
- G. Provide wall plates, type, finish, and material to match other wiring devices; see Section 26 27 26.
- H. Provide required supports; see Section 26 05 29.
- I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- J. Occupancy Sensor Locations:
 - 1. Location Adjustments: Within design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- K. Outdoor Photo Control Locations:
 - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
 - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by photo control itself.
- L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into photo control.

- M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near sensor location.
- N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
- O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.
- P. Where indicated or required, provide cabinet or enclosure for mounting of lighting control device system components; see Section 26 05 33.16.

3.04 FIELD QUALITY CONTROL

- A. See Division 01 Quality Requirements for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- F. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Engineer/Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust time switch settings to achieve Owner's desired operation schedule as indicated or as directed by Engineer/Architect.
- F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Engineer/Architect.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Engineer/Architect, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION

SECTION 26 24 16 PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 03, Cast-in-Place Concrete: concrete equipment pads.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2025.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- N. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 2. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Division 01 Product Requirements for additional provisions.
 2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric: www.se.com/#sle.
- D. Siemens Industry, Inc: www.new.siemens.com/#sle.
- E. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide painted steel boxes for surface-mounted panelboards, finish to match fronts.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

- J. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- K. Load centers are not acceptable.
- L. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Feed-through lugs.
 - 2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Aluminum or copper.
 - 2. Ground Bus Material: Aluminum or copper.
- D. Circuit Breakers:
 - 1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
 - 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures unless otherwise indicated.
 - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Phase and Neutral Bus Material: Aluminum or copper.
 - 3. Ground Bus Material: Aluminum or copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures as indicated.
 - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - b. Provide interchangeable trip units for circuit breaker frame sizes 400 amperes and larger.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
 - c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
 - d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
 - e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
7. Provide listed switching duty rated circuit breakers with SWD marking where indicated.
8. Do not use tandem circuit breakers.
9. Do not use handle ties in lieu of multi-pole circuit breakers.
10. Provide circuit breaker handle-ties for existing multi-wire branch circuits as required by NFPA 70.
11. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - c. Handle Clamp (lock-on device): Set-screw type mechanism for locking circuit breaker handle in ON position.

2.06 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install panelboards plumb.
- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- H. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Division 03 Cast-in-Place Concrete.
- I. Provide grounding and bonding in accordance with Section 26 05 26.
- J. Install all field-installed branch devices, components, and accessories.
- K. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- L. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- M. Set field-adjustable circuit breaker tripping function settings as indicated.
- N. Provide filler plates to cover unused spaces in panelboards.
- O. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Fire detection and alarm circuits.

3.03 FIELD QUALITY CONTROL

- A. See Division 01 Quality Requirements for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 250 amperes. Tests listed as optional are not required.
- D. Test GFCI circuit breakers to verify proper operation.
- E. Test AFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.

- G. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 27 26 WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates and covers.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.
- M. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.

5. Notify Engineer/Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
 - B. Sequencing:
 1. Do not install wiring devices until final surface finishes and painting are complete.
- 1.05 SUBMITTALS
- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 1. Wall Dimmers: Include derating information for ganged multiple devices.
 - B. Project Record Documents: Record actual installed locations of wiring devices.
- 1.06 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
 - B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 - C. Products: Listed, classified, and labeled as suitable for the purpose intended.
 - D. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.
- 1.07 DELIVERY, STORAGE, AND PROTECTION
- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICES - GENERAL REQUIREMENTS

- A. Provide wiring devices suitable for intended use with ratings adequate for load served.
- B. Except where explicitly permitted, substitution of combination switch-and-receptacle devices for separate switches and receptacles is not permitted.
- C. Wiring Device Applications:
 1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with metallic weatherproof while-in-use covers.
- D. Wiring Device Finishes:
 1. Provide wiring device finishes as described below, unless otherwise indicated.
 2. Wiring Devices, Unless Otherwise Indicated: Gray with stainless steel wall plate.

2.02 WALL SWITCHES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 4. Arrow Hart, a brand of Eaton.
- B. General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.03 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- C. Control: Slide control type with separate on/off switch.
- D. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:
 - 1. Incandescent: 600 W.
 - 2. Magnetic Low-Voltage: 600 VA.
 - 3. Electronic Low-Voltage: 400 VA.

2.04 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 4. Arrow Hart, a brand of Eaton.
- B. General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
 - 3. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
 - 4. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
 - 1. General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 - 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
 4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
 5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
- E. USB Charging Devices:
1. General Requirements: Listed as complying with UL 1310.
 - a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.
 2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.
- F. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

2.05 WALL PLATES AND COVERS

- A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
 2. Intermatic, Inc: www.intermatic.com/#sle.
 3. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 4. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 5. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Weatherproof Receptacle Covers for Wet or Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.
1. Nonmetallic covers are not acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
 - 1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 3. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Engineer/Architect to obtain direction prior to proceeding with work.
 - 4. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices, unless noted otherwise on the Drawings.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.04 FIELD QUALITY CONTROL

- A. See Division 01 Section on Quality Requirements for additional requirements.

- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Engineer/Architect.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 28 13 FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.
- E. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
 - 1. Spare Fuse Cabinet: Include dimensions.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Fuses: One set(s) of three for each type and size installed.
 - 2. Fuse Pullers: One set(s) compatible with each type and size installed.
 - 3. Spare Fuse Cabinet Keys: Two.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.
- B. Littelfuse, Inc: www.littelfuse.com/#sle.
- C. Mersen: ep-us.mersen.com/#sle.

2.02 APPLICATIONS

- A. Service Entrance:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- B. Feeders:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

2.03 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
- H. Class L Fuses: Comply with UL 248-10.
- I. Provide the following accessories where required to complete installation:
 - 1. Fuseholders: Compatible with indicated fuses.

2.04 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
- B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet in convenient location in main electrical room unless otherwise indicated.
- D. Identify spare fuse cabinet in accordance with Section 26 05 53.

END OF SECTION

**SECTION 26 28 16.16
ENCLOSED SWITCHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Project Record Documents: Record actual locations of enclosed switches.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Division 01 Product Requirements for additional provisions.
 - 2. See Section 26 28 13 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 ENCLOSED SAFETY SWITCHES

- A. Manufacturers:
 - 1. ABB: www.electrification.us.abb.com/#sle.
 - 2. Eaton Corporation: www.eaton.com/#sle.
 - 3. Schneider Electric: www.se.com/#sle.
 - 4. Siemens Industry, Inc: www.siemens.com/#sle.
 - 5. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.
- B. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- E. Horsepower Rating: Suitable for connected load.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Minimum Ratings:
 - a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
- H. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- I. Provide with switch blade contact position that is visible when the cover is open.
- J. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- K. Conductor Terminations: Suitable for use with the conductors to be installed.
- L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- N. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- P. Heavy Duty Switches:
 1. Comply with NEMA BS 31047.
 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
- Q. Provide the following features and accessories where indicated or where required to complete installation:
 1. Hubs: As required for environment type; sized to accept conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Identify enclosed switches in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Division 01 Quality Requirements for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

**SECTION 26 51 00
INTERIOR LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Integral emergency power supply units.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 09 23 - Lighting Control Devices.
 - 1. Includes automatic controls for lighting including occupancy sensors, time switches, outdoor photo controls, and daylighting controls.
 - 2. Includes lighting contactors.
- E. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.

1.03 REFERENCE STANDARDS

- A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019 (Reaffirmed 2025).
- B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.
- F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- K. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Engineer/Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 - 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
 - 3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
 - 4. Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Division 01, Product Requirements for additional provisions.
 - 2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
 - 3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
 - 4. Extra Drivers: Two percent of total quantity installed for each type, but not less than one of each type.
- G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Division 01, Closeout Submittals for additional warranty requirements.
- B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.
- C. Provide 5-year pro-rata warranty for batteries for emergency lighting units.
- D. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.
- E. Provide 5-year full warranty for emergency power supply units.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, drivers, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 - 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
 - 3. Provide compatible accessory wire guards where indicated.
 - 4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 - 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
 - 1. Self-Powered Exit Signs:
 - a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 - b. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 - c. Provide low-voltage disconnect to prevent battery damage from deep discharge.
 - d. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

2.05 BALLASTS AND DRIVERS

- A. Ballasts/Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 - 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

2.06 INTEGRAL EMERGENCY POWER SUPPLY UNITS

- A. Description: Self-contained emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Compatibility:
 - 1. Ballasts: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.
- C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamps to emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.

2.07 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.

3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 4. Secure pendant-mounted luminaires to building structure.
 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
- I. Suspended Luminaires:
1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 2. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
 3. Install canopies tight to mounting surface.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.
- M. Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- N. Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- O. Remote Ballasts: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

3.04 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test self-powered exit signs, emergency lighting units, and integral emergency power supply units to verify proper operation upon loss of normal power supply.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer/Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer/Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Engineer/Architect or authority having jurisdiction.

- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Engineer/Architect or authority having jurisdiction.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Engineer/Architect, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all fixtures or drivers that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

**SECTION 26 56 00
EXTERIOR LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts and drivers.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019 (Reaffirmed 2025).
- B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
- F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Notify Engineer/Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Shop Drawings:
 - 1. Provide photometric calculations where luminaires are proposed for substitution.
 - 2. Provide structural calculations for each pole.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
- D. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 WARRANTY

- A. See Division 01 for additional warranty requirements.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. LED Luminaires:
 1. Components: UL 8750 recognized or listed as applicable.
 2. Tested in accordance with IES LM-79 and IES LM-80.
 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 BALLASTS AND DRIVERS

- A. Ballasts/Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 - 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- H. Install accessories furnished with each luminaire.
- I. Bond products and metal accessories to branch circuit equipment grounding conductor.
- J. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer/Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer/Architect. Secure locking fittings in place.

- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Engineer/Architect.

3.06 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Engineer/Architect, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

**SECTION 28 46 00
FIRE DETECTION AND ALARM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire alarm system and associated components, including control units, related equipment, initiating devices, and notification appliances.
- B. Fire alarm system shall be capable to cover both the area of renovation indicated on the drawings and future expansion for the remainder of the facility, compliant with this specification and all local and state requirements, to provide a fully-integrated system throughout the entire facility.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.

1.03 ABBREVIATIONS AND ACRONYMS

- A. AHJ: Authorities having jurisdiction.
- B. BAS: Building automation system.
- C. DMNS: Distributed mass notification system.
- D. ECS: Emergency communications system.
- E. EoL: End-of-line.
- F. EVACS: Emergency voice/audio communication systems.
- G. FACU: Fire alarm control unit.
- H. HVAC: Heating, ventilation, and air conditioning.
- I. IDC: Initiating device circuit.
- J. LAN: Local area network.
- K. MNS: Mass notification system.
- L. NAC: Notification appliance circuit.
- M. NPLFA: Non-power-limited fire alarm.
- N. PLFA: Power-limited fire alarm.
- O. SLC: Signaling line circuit.
- P. SOO: Sequence of operation.
- Q. SPD:

1.04 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA 305 - Standard for Fire Alarm System Job Practices; 2018.

- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- I. NFPA 1225 - Standard for Emergency Services Communications; 2022.
- J. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.
- K. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.
- L. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.
- M. UL 497B - Standard for Protectors for Data Communications and Fire-Alarm Circuits; Current Edition, Including All Revisions.
- N. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems; Current Edition, Including All Revisions.
- O. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.
- P. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- Q. UL 1480 - Standard for Speakers for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.
- R. UL 1711 - Amplifiers for Fire Protective Signaling Systems; Current Edition, Including All Revisions.
- S. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.
- T. UL 2075 - Standard for Gas and Vapor Detectors and Sensors; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate arrangement of equipment with dimensions and clearance requirements of actual equipment.
 - 2. Coordinate placement of devices and notification appliances with potential conflicts or view obstructions.
 - 3. Coordinate work to provide power for equipment at required locations (e.g., smoke dampers, type of actuators, line or local control transformer, zoning, grouping and circuit activations).
 - 4. Coordinate fire suppression system device requirements, monitoring, control, and associated interconnections.
 - 5. Coordinate requirements for branch circuit protection, identification, and shunt trip if applicable.
 - 6. Coordinate kitchen equipment requirements for fire alarm system interconnections based on selected equipment.
 - 7. Coordinate reflected ceiling plans to avoid conflicting placements; maintain minimum diffuser and detector clearances as indicated.
 - 8. Coordinate submittals to confirm equipment and associated components are capable of indicated settings, and manufacturer documentation identifies required compatible product listings.

9. Notify Engineer/Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meetings:
 1. Conduct meeting with facility representative to review devices, notification appliances, and equipment locations.
 2. Conduct meeting with facility representative and other related equipment manufacturers to discuss fire alarm system interface requirements.
 3. Conduct meeting to review anticipated installation of code-required smoke control requirements, product solutions, and SOO.
 4. Convene one week before starting work for review of documented SOO for system applications.
- C. Sequencing:
 1. Verify exact termination locations required for boxes, enclosures, and equipment.
 2. Do not install devices or notification appliances until final surface finishes, painting, and cleaning are complete, unless otherwise required by AHJ.
 3. Do not begin installation of conductors and cables until installation of conduit and pathways between termination points is complete.
 4. Sequence work to protect cabling (e.g., overspray painting, physical stress, and insulation damage or covering markings).
 5. Verify naming convention for equipment identification, including room names and numbers, prior to creation of final drawings, reports, and labels.
- D. Scheduling:
 1. Arrange access to facility for data collection with facility representative.
 2. Where work involves interruption of existing electrical or fire alarm system service, arrange interruption with Owner.
 - a. Arrange test start and end with responsible reporting service. Confirm system normal operating mode and record as-found and as-left settings.
 - b. Arrange work to disable individual devices or circuits for minimal disruption if possible.
 - c. Arrange in accordance with NFPA 72 fire alarm system impairment requirements.
 - d. Where required by AHJ, arrange systems or partial system out of service interruption in accordance with requirements of building, life safety, and fire codes (e.g., approved fire watch plus required notifications, tags at each fire department connection and control valve, and AHJ notification when excess hours).

1.06 SUBMITTALS

- A. Evidence of designer qualifications.
- B. Comply with NFPA 72 chapter "Documentation," including noting names of installers, owners, and system classification information.
- C. Design Documents: Submit all information required for plan review and permitting by AHJ, including floor plans, riser diagrams, and description of operation.
 1. Copy (if any) of list of data required by AHJ.
 2. NFPA 72 "Record of Completion", filled out to extent known at time.
 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A, and complete listing of software required.
 4. Manufacturer's detailed product data sheet for each component, including wiring diagrams, and circuit length limitations. Catalog pages and product descriptions include ratings, dimensions, finishes, service conditions, and included features.
 5. Certification by manufacturer of FACU that system design complies with Contract Documents.
 6. Certification by Contractor that system design complies with Contract Documents.

- D. Shop Drawings: Submit installation documentation required for plan review and permitting by AHJ, including floor plans showing locations of fire alarm system components, enlarged drawn to identified scale plan view, and riser diagrams.
 - 1. System zone boundaries and interfaces to fire safety systems.
 - 2. Show locations of components, circuits, and raceways; mark components with identifiers used in control unit programming.
 - 3. Include elevations and details of proposed equipment arrangements.
 - 4. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application specific information required by NFPA 72.
 - 5. Include typical wiring diagrams for devices, notification appliances, remote indicators, annunciators, remote test stations, and EoL and power supervisory devices.
 - 6. Include requirements and control diagrams for interfacing with other systems.
 - 7. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; standby and spare capacity calculations; notification appliance circuit loop resistance and voltage drop calculations, including spare capacity.
 - 8. List of devices and notification appliances on each SLC, with spare capacity indicated.
 - 9. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 - 10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 - 11. Detailed drawing of graphic annunciators, displays, and interfaces.
 - 12. Certification by either FACU manufacturer or manufacturer of related equipment.
 - 13. Certification by FACU manufacturer that system design complies with Contract Documents.
 - 14. Certification by Contractor that system design complies with Contract Documents.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Evidence of installer qualifications.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. Inspection and Test Reports:
 - 1. Submit inspection and test plan prior to closeout demonstration.
 - 2. Submit documentation of satisfactory inspections and tests.
 - 3. Submit NFPA 72 "Inspection and Test," filled out.
- I. Operating and Maintenance Data: Revise and resubmit until acceptable; have one set available during closeout demonstration:
 - 1. Complete set of specified design documents, as approved by AHJ.
 - 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 - 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 - 4. List of recommended spare parts, tools, and instruments for testing.
 - 5. Replacement parts list with current prices, and source of supply.
 - 6. Detailed troubleshooting guide and large scale input/output matrix.
 - 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 - 8. Detailed but easy to read explanation of procedures require recording of system trouble events by qualified personnel, such as when routine testing is being conducted for fire drills and when entering into contracts for building renovations.

- J. Project Record Documents: See Division 01 for additional record document requirements, have one set available during closeout demonstration:
 - 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 - 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 - 3. "As programmed" operating sequences, including control events by device, and updated input/output chart.
 - a. ECS: Voice messages by event.
- K. Closeout Documents:
 - 1. Certification by manufacturer that system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 - 2. NFPA 72 "Record of Completion," filled out completely and signed by installer and authorized representative of AHJ.
 - 3. Certificate of Occupancy.
 - 4. Maintenance contract.
- L. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
 - 1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data.
 - 2. In addition to items in quantities indicated in PART 2, furnish the following:
 - a. Tools, software, and documentation necessary to modify fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, notification appliances, circuits, and zones, and changes to system description, and operation.
 - 1) ECS: Include same capability for evacuation and instructional messages.
 - b. One copy of software not resident in read-only-memory.
 - c. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.
 - d. Extra Cabinet Keys: Six spare for each cabinet lock provided; label key number and corresponding cabinet identifier; collect and provide to Owner facility manager.

1.07 QUALITY ASSURANCE

- A. Copies of Design Criteria Documents: For duration of project, maintain at project site copy of each referenced document that prescribes execution requirements; bound together. Also, NFPA 72, relevant portions of other applicable codes, and instructions and guidelines of AHJ. Include in submittals upon completion.
- B. Designer Qualifications: NICET Level III (three) or Level IV (four) certified fire alarm technician or registered fire protection engineer, employed by FACU manufacturer, Contractor, or installer, with experience designing fire alarm systems in jurisdictional area of AHJ.
- C. Installer Qualifications: Firm with minimum three years documented experience installing fire alarm systems of specified type and providing contract maintenance service as regular part of their business.
 - 1. Authorized representative of FACU manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 - 2. Installer Personnel: At least two years of experience installing fire alarm systems.
 - 3. Supervisor: Level III (three) or Level IV (four) certified fire alarm technician; furnish name and address.
 - 4. Contract maintenance office located within 50 miles of project site.

- 5. Certified in the State in which the Project is located as fire alarm installer.
 - D. Manufacturer Qualifications: Company specialized in manufacturing products specified in this section with at least three years of documented experience.
 - E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
 - F. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL), and acceptable to AHJ.
- 1.08 DELIVERY, STORAGE, AND HANDLING
- A. See Division 01 Construction Waste Management and Disposal for packaging waste requirements.
 - B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 305.
 - C. Handle carefully to avoid damage to internal components, enclosure, and finish.
 - D. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.
- 1.09 FIELD CONDITIONS
- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
 - B. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.
 - C. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer/Architect and obtain direction before proceeding with work.
- 1.10 WARRANTY
- A. Fire Alarm Control Units and Accessory Equipment: Provide minimum 3-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
 - B. Fire Alarm Manual Pull Stations: Provide minimum 1-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
 - C. Fire Alarm System Detectors: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
 - D. Fire Alarm System Notification Appliances: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 FIRE ALARM SYSTEM

- A. General Requirements:
 - 1. Provide new fire alarm system complying with NFPA 70, NFPA 72, NFPA 90A, and consisting of required equipment, conduit, cabinets, outlet boxes, wiring, connectors, hardware, supports, accessories, components, software, and system programming as necessary for complete operating system that provides functional intent indicated.
 - 2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. 36 CFR 1191 and ADA Standards.

- b. Requirements of State Fire Marshal.
 - c. Requirements of AHJ.
 - d. Applicable local codes.
 - e. Contract Documents.
 - f. NFPA 72; "should" is mandatory; where conflicts between requirements require deviation, identify deviations clearly on design documents.
- 3. Fire Alarm System Products:
 - a. Listed, classified, and labeled as suitable for purpose intended.
 - b. Installation Environments: Provide products suitable for their respective indoor and outdoor applications.
- 4. Fire Alarm System Design Information:
 - a. Building Code: Comply with applicable building code.
 - 1) Principle Occupancy: As indicated on Architect code summary drawings.
 - 2) Principle Use: As indicated on Architect code summary drawings.
 - 3) Occupant Evacuation Method: Total building.
 - 4) Equipment Room Rating: See drawings.
 - 5) Fire Suppression System: Fully sprinkled.
 - (a) Types:
 - b. NFPA 72 Fire Alarm System Classification: Supervising central station.
 - c. Smoke and Heat Detector Coverage: Partial or selective coverage in accordance with NFPA 72.
 - d. Signal Priorities:
 - 1) See fire alarm system matrix indicated on drawings.
 - e. Notification Appliance Zones:
 - 1) See fire alarm system floor plans on drawings.
 - f. Emergency Communications Systems (ECSs):
 - 1) Design in accordance with intelligibility requirements listed in NFPA 72.
 - 2) One-Way ECS:
 - (a) In-building fire EVACS.
 - (b) In-building MNS:
 - (1) Combination system.
- 5. Provide fire alarm circuits in accordance with NFPA 70.
 - a. Comply with methods of interconnecting FACUs in accordance with NFPA 72 and NFPA 70.
 - b. Power Sources:
 - 1) Comply with requirements for power supplies of emergency systems in accordance with NFPA 70.
 - 2) Primary: Dedicated branch circuits from facility power distribution system.
 - 3) Secondary: Storage batteries with capacity to operate system for period specified by NFPA 72.
 - c. Wiring and Wiring Methods:
 - 1) General Requirements:
 - (a) Comply with requirements for wiring and wiring methods in accordance with NFPA 70.
 - (b) Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum-rated, listed and labeled as suitable for use in return air plenums.
 - (c) Special Occupancies: Comply with NFPA 70.

- (d) Comply with NFPA 70 for wire and cable plenum, riser, general-purpose, limited-use, undercarpet, and underground applications.
 - 2) Fire Alarm Circuits:
 - (a) Comply with NFPA 70 for conditions and types required for multiconductor cable systems.
 - (b) Non-Power-Limited Fire Alarm (NPLFA) Circuits:
 - (1) Provide dedicated NPLFA non-GFCI branch circuits for fire alarm equipment and marked by red identification in accordance with NFPA 70.
 - (c) Power-Limited Fire Alarm (PLFA) Circuits:
 - (1) Provide identification for PLFA circuits in accordance with NFPA 70.
- 6. Provide pathway class designations and pathway survivability, as defined in NFPA 72.
 - a. Provide monitoring of conductors and other signaling channels for integrity and circuit performance.
 - b. Pathway Class Designations:
 - 1) Unless otherwise indicated or required, pathways to meet the following requirements:
 - (a) SLCs: Class B (star, tee-tap, multi-tap, with no return).
 - (b) IDCs: Class B (daisy-chain with EoL resistor device installed at end of circuit).
 - (c) NACs: Class B (daisy-chain with EoL resistor device installed at end of circuit).
 - (d) Other Wiring:
 - (1) Other life safety control features not covered above (e.g., door holder circuits, elevator recall circuits, fire smoke dampers, and air handling system interfaces), wired as Class D (failsafe, intended operation is performed in event of pathway failure).
 - (2) Where Class D wiring is not possible due to limitation of equipment, wiring limited to 3-feet between addressable control module and equipment and be installed in metallic conduit.
 - c. Pathway Survivability:
 - 1) Unless otherwise indicated or required, pathways to meet requirements for Pathway Survivability Level 1 (nonrated cable installed in metal raceway, building protected by automatic sprinkler system).
- 7. Spare System Capacity:
 - a. SLCs: Minimum 25 percent spare capacity.
 - b. NACs: Minimum 25 percent spare capacity.
- 8. Secondary Power Source - Battery Storage Capacity:
 - a. Provide standby (nonalarm) operation sufficient for 24 hours.
 - b. Provide additional alarm operation for 15 minutes.
 - c. Calculate combined of standby load plus alarm load for overall battery storage capacity requirements, per power supply.
 - d. Provide 25 percent additional overall battery capacity correction factor.
- B. Fire Alarm System Interfaces and Control Functions:
 - 1. UL 864 listed unless otherwise indicated.
 - 2. Descriptions below are intended to provide means for interface. See project SOOs, narrative, and input/output matrix for execution requirements.

3. Provide initiating devices, interfaces, and control functions for emergency control function interfaces in accordance with NFPA 72.
4. Provide monitoring of interconnected systems. Coordinate notification appliance alternate markings as indicated on drawings.
5. Fire Suppression Systems:
 - a. Provide minimum of four monitoring point inputs per system unless otherwise indicated.
 - b. Kitchen Hood Suppression Systems: Provide minimum of one monitoring point input per system.
 - c. Fire Sprinkler Systems:
 - 1) Waterflow Switches: Provide minimum of one monitoring point input per switch.
 - 2) Control Valve Supervisory (Tamper) Switches: Provide minimum of one monitoring point input per switch.
 - 3) Pressure Supervisory (High/Low Pressure) Switches: Provide minimum of two monitoring point inputs per switch (separate points for high/low pressure signals).
 - 4) Preaction Control Panels: Provide minimum of four monitoring point inputs per system.
6. Emergency Communication Systems (ECS):
 - a. Provide minimum of six monitoring point inputs per system, including associated enhancement systems.
7. Other Interconnected Systems: For systems listed below, provide minimum of two monitoring point inputs each.
 - a. Gas Detection Systems: Including providing notification appliances as indicated on plans for CO - Carbon Monoxide.
8. HVAC Systems:

2.02 FIRE ALARM CONTROL UNITS AND RELATED EQUIPMENT

- A. Manufacturers:
 1. Edwards Fire Safety.
 2. Honeywell International, Inc; Fire-Lite.
 3. Honeywell International, Inc; Honeywell Gamewell-FCI: www.honeywell.com/#sle.
 4. Honeywell International, Inc; Honeywell Notifier: www.honeywell.com/#sle.
 5. Potter Electric Signal Company: www.pottersignal.com/#sle.
 6. Johnson Controls, Inc; Simplex.
 7. Siemens Industry: www.siemens.com/#sle.
 8. Silent Knight..
 9. Source Limitations: Furnish FACUs and related equipment produced by single manufacturer and obtained from single supplier.
- B. Fire Alarm Control Units and Related Equipment: Listed and labeled as complying with UL 864.
- C. Provide cabinets and enclosures as indicated or as required to house system components.
- D. Seismic Qualification: Provide fire alarm system and associated components suitable for application under project seismic design criteria where required. Include certification of compliance with submittals.
- E. Fire Alarm Control Unit (FACU): Addressable.
 1. SLCs and IDCs: Configurable for Class B or Class A with additional modules.
 2. NACs: Integral and programmable with synchronization modules or cards as required.
 3. Power Supply: 120 VAC, 60 Hz, supplying necessary power for FACU.

4. User-Interface: Touchscreen display for system interfacing and service mode settings, include password and user credentials; configurable for custom actions and incorporates historical event log.
 5. Support self-testing detector capability.
 6. Remote Annunciator Support: Up to 10.
 7. Provide NAC expansion as required.
 8. Networking: System shall be capable of expansion to serve entire building or networkable to achieve same full facility coverage..
 9. ECS: FACU listed for purpose.
 10. Enclosure Finish Color: Red, or manufacturer's standard color if red is unavailable..
 11. Products:
 - a. Basis-of-Design: Edwards Fire Safety EST3.
- F. Notification Appliance Circuit Expansion:
1. Where notification appliance circuit requirements exceed capacity of FACU, provide accessories and cabinets as required for expansion.
- G. Networking:
1. Comply with NFPA 70.
 2. FACU capable of communicating over network utilizing peer-to-peer, inherently regenerative communication and format.
 3. Provide network repeaters as required.
- H. Emergency Communications System (ECS):
1. Comply with NFPA 1225.
 2. Voice Integration: UL 864- and UL 2572-listed control panel for distributed signaling processing (DSP)-based emergency voice/alarm evacuation system (EVACS);
 3. Amplifiers listed and labeled as complying with UL 1711.
 - a. 70 Vrms; twisted pair copper wire, single-mode fiber optic, and multimode fiber optic media; distributed (up to 150 W per cabinet) amplifiers.
 4. FACU Listed for ECS:
 - a. Provide digital ECS integrated with FACU and capable of automatic and manual paging, messaging, evacuation, and alerting on selective and all-call basis.
 - b. Provide all-call and total evacuation necessary switch points of command, manual controls of evacuation and paging, per zone, prerecorded messaging for nonemergency voice notifications, door unlock provisions, and commands for speaker bypass, unless otherwise approved by Engineer and AHJ.
 - 1) Provide paging microphone.
 - c. Provide minimum of six switch points of command for speaker bypass, visual bypass, elevator recall bypass, door control bypass, HVAC bypass, and auxiliary bypass.
 - d. Remote Interface Displays: Provide network graphic display, color touchscreen display, and panel LCD keypad display.
 - e. Local and Remote Transponders:
 - 1) Audio hardware, including multiple primary and backup amplifiers, speaker circuit interfaces, power supplies, supervision hardware, cabinets, and battery backup systems may be configured to support multiple notification zones and packaged as audio transponders.
 - 2) Transponders considered system control equipment and located, installed, and interfaced accordingly.
 - 3) Provide firefighter's telephone or other ECS in accordance with NFPA 72.
- I. Addressable Interface Modules:

1. General Requirements:
 - a. Provide addressable modules suitable for connection to FACU SLCs.
 - b. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.
 2. Addressable Monitor Modules: Unless devices are explicitly permitted to be connected together on one zone; provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable FACU.
 3. Addressable Control Modules: Provide as indicated or as required for selective control of notification appliances.
 4. Addressable Relay Modules:
 - a. Provide as indicated or as required to perform necessary functions via dry-contact interface.
 - b. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.
- J. Alarm Communication:
1. Protected Premises Alarm and Signaling Systems:
 - a. Provide accessories as required for interface as indicated and as required by AHJ.
 - b. Provide accessories in accordance with building code, fire code, and life safety code requirements for occupancy classifications and use cases.
 - c. Include software and firmware control, required features, special requirements for low-power radio (wireless) systems, and fire alarm system interconnections required by NFPA 72.
 2. Supervising Station Alarm Systems:
 - a. Provide accessories as required for interface with supervising station as indicated and as required by AHJ.
 - b. Communication Method: Dual path, internet protocol (IP) primary with cellular backup.
 - c. Supervise communication paths at interval required by NFPA 72.
- K. Remote Annunciators:
1. LCD Remote Annunciators:
 - a. Provide backlit LCD display that mimics FACU display.
 - b. Provide dedicated status indications for power and alarm, supervisory, and trouble conditions.
 - c. Enable system control functions including acknowledge, silence, and reset.
 - d. Provide local audible alarm.
 - e. Mounting: Wall-mounted; provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
- L. Drill Switch
1. Provide integral to FACU and remote annunciators.
 2. Drill Switch Operation Actions:
 - a. Cause an LED to flash on the FACU.
 - b. Initiate notification appliances.
 - c. Release fire and smoke doors held open by magnetic door holders.
 - d. Provide a signal to the intercom system for tone generation.

2.03 FIRE ALARM SYSTEM INITIATING DEVICES

A. Manufacturers:

1. Source Limitations: Furnish initiating devices produced by same manufacturer as FACUs where possible.
- B. General Requirements:
 1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable FACU; suitable for connection to FACU SLCs.
 - b. Conventional/Nonaddressable Devices: Provide addressable interface modules as indicated or as required for connection to addressable FACU. Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitoring point for each device in order to be individually identifiable by addressable FACU.
 2. Provide devices and associated accessories suitable for intended application and location to be installed. Unless otherwise indicated, use addressable devices and addressable interface modules only in clean, dry, indoor, nonhazardous locations.
 3. Surface-Mounted Devices: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
 4. Devices for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes or enclosures in accordance with product listing.
 5. Devices for Hazardous/Classified Locations: Listed and labeled as suitable for classification of installed location.
- C. Manual Fire Alarm Boxes/Pull Stations:
 1. Description: Noncoded manual signaling boxes listed and labeled as complying with UL 38.
 2. Alarm Initiation: Configured for general alarm initiation unless otherwise indicated; presignal stations (where indicated) require use of key to initiate general alarm.
 3. Operation: Dual-action unless otherwise indicated or required.
 - a. Dual-Action Operation: First requires pushing, pulling, or lifting, then pulling of lever.
 4. Color: Red, in accordance with NFPA 72.
 5. Station Reset: Requires use of key or tool.
- D. Spot-Type Detectors:
 1. Utilize plug-in mounting to separate base with tamper-resistant feature; provide bases as indicated or as required.
 2. Addressable Detectors:
 - a. Provide LED indication of normal operation and regular communication with FACU and alarm condition.
 - b. Provide reporting of analog sensor values to FACU.
 3. Smoke Detectors:
 - a. Listed and labeled as complying with UL 268.
 - b. Provide sensor type (e.g., photoelectric, ionization) as indicated.
 - c. Provide automatic drift compensation.
 4. Thermal/Heat Detectors:
 - a. Listed and labeled as complying with UL 521.
 - b. Provide sensor type (e.g., fixed temperature, rate-of-rise) and rating as indicated.
 5. Carbon Monoxide Detectors:
 - a. Listed and labeled as complying with UL 2075.
 - b. Provide end-of-life notification.
- E. Accessories:
 1. Provide Detector Bases As Indicated:

- a. Color: White, unless otherwise indicated.

2.04 FIRE ALARM SYSTEM NOTIFICATION APPLIANCES

A. Manufacturers:

- 1. Source Limitations: Furnish notification appliances produced by same manufacturer as FACUs where possible.

B. General Requirements:

- 1. Provide signaling notification appliances listed for fire-protective service and intended operating mode, public or private; suitable for connection to FACU notification appliance circuits.
- 2. Provide notification appliances and associated accessories suitable for intended application and location to be installed. Use notification appliances only according to listed mounting (e.g. ceiling, wall).
- 3. Surface-Mounted Notification Appliances: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
- 4. Concealed Notification Appliances:
 - a. Upon activation from fire alarm system, expose device for operation; return to concealed position upon system deactivation; motor-driven.
 - b. Provide door position monitoring system for remote indication of concealed and exposed positions.
- 5. Exterior Notification:
 - a. In addition to required occupant notification, provide notification appliances on exterior of building where indicated.
 - b. Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes or enclosures in accordance with product listing.
 - c. Visible Notification: Provide strobe beacon with red lens; interface to dedicated NAC or addressable control module, 24 VDC, supervised.
- 6. Notification Appliance Derating: Include device derating adjustments in accordance with listing where applicable, including the following.
 - a. Where accessory protective guards or enclosures are utilized.
 - b. Where required by field conditions (e.g., ambient temperature and sound).
- 7. Notification Appliance Color:

C. Visible Notification Appliances:

- 1. Public Mode Operation: Listed and labeled as complying with UL 1971.
- 2. Strobes: Clear or nominal white lens with flash rate of 1 Hz unless otherwise indicated or required; xenon or LED light source with maximum pulse duration of 0.02 seconds; candela rating as indicated.
 - a. Provide field-selectable 15/30/75/110 candela devices.
 - b. Where field-selectable candela strobes are specified, substitution of fixed candela strobes is not permitted.

D. Audible Notification Appliances:

- 1. Listed and labeled as complying with UL 464.
- 2. Rated Sound Pressure Level: As required to achieve design sound pressure levels, but not less than 75 dBA at 10 feet for public mode operation or 45 dBA at 10 feet for private mode operation in accordance with UL 464.

E. Speakers for ECS:

- 1. Listed and labeled as complying with UL 1480.
- 2. Rated Sound Pressure Level: As required to achieve design sound pressure levels, but not less than 75 dBA at 10 feet in accordance with UL 1480.

3. Frequency Range: 400 to 4,000 Hz minimum in accordance with UL 1480; listed for producing 520 Hz low frequency alarm signal for sleeping areas in accordance with NFPA 72.
 4. Speaker Voltage: Field configurable, matched to audio distribution circuit voltage.
 5. Provide minimum of four field-selectable power taps.
- F. Combination Notification Appliances: Comply with respective requirements for each signaling method.
- G. Accessories:
1. Notification Appliance Bases: White, unless otherwise indicated.

2.05 WIRE AND CABLE

- A. Manufacturers:
1. Belden.
 2. Carol.
 3. Southwire Genesis.
 4. West Penn.
- B. General Requirements:
1. Comply with NFPA 70 listing and marking requirements for cables.
 - 2.
 3. Substitution of fire alarm listed cables for communication wiring, in accordance with NFPA 70, is not permitted.
 4. Provide cables as indicated or as required for connections between system components.
 - a. Data Cables for IP Network Connections: Unshielded twisted pair (UTP) complying manufacturer's minimum requirements.
- C. Power-Limited Fire Alarm Cables (PLFA):
1. Comply with applications of listed cables in accordance with Chapter 7 of NFPA 70.
 - a. Type FPLP plenum fire alarm cable, NFPA 262, UL1424 listed.
 - b. Fire alarm cable substitutions in accordance with NFPA 70: Permitted.
- D. Non-Power-Limited Fire Alarm Cables (NPLFA):
1. Comply with NPLFA circuit conductor properties in accordance with NFPA 72.
 2. Comply with listing requirements in Chapter 7 of NFPA 70.
- E. Armored Cable (AC) or Metal clad (MC) Fire Alarm Cable
1. Manufacturers:
 - a. AFC Cable Systems.
 - b. Cerrowire.
 - c. Encore Wire.
 - d. Southwire.
 2. Shall be marked in red or red striping.
 3. May be used in concealed locations above accessible ceilings only.

2.06 ACCESSORIES

- A. Provide components as indicated or as required for connection of fire alarm system to devices and other systems indicated.
- B. Provide EoL resistors as required for wiring supervision.
- C. Protective Covers for Fire Alarm Devices:
1. Listed to same standard as device being protected.
 2. Outdoor Covers: Weather resistant, suitable for outdoor use; use only with outdoor-rated devices.

3. Provide guards to protect devices where subject to mechanical damage; listed for use with detector.
 - a. Protective Covers for Manual Pull Stations:
 - 1) Provide protective covers with hinged access for manual pull stations.
 - 2) Listed and labeled as complying with UL 38.
 - 3) Outdoor Covers: Weather resistant, suitable for outdoor use; use only with outdoor rated devices.
 - 4) Provide integral battery-powered horn activated by lifting cover for false alarm deterrent.
- D. Surge Protection:
 1. Line Voltage Surge Protection:
 - a. Provide for each line voltage circuit serving fire alarm system control units and related equipment (e.g., FACU, field booster panels, nodes, and transponders).
 - b. Listed and labeled as complying with UL 1449.
 - c. Products:
 - 1) Provide surge protective device (SPD) in a listed enclosure near the electrical panelboard and trim excess lead lengths. Surge protective device for main fire alarm panel shall be UL 1449 (latest edition) listed, 130V MCOV, VPR 700V L-N, L-G; 600V N-G protection modes, 19.5 kA peak surge current, Ditek DTK-120-HWLOK or approved equal.
 - 2) Label SPD enclosure as "FACU SPD" with electrical panel/circuit identified.
 2. Low Voltage Surge Protection:
 - a. Provide for each power-limited fire alarm circuit that enters or exits a building and into and out of main and extender panels.
 - b. Listed as complying with UL 497B.
 - c. Provide voltage/current ratings suitable for circuit to be protected.
 - d. Products:
 - 1) Provide Ditek DTK-2MLP24B (with base) installed at both ends. Place SPD in its own enclosure and not into fire alarm panels. If installed in the ceiling, location shall be marked by placing a lime green adhesive dot/label on the ceiling grid and marked on the fire alarm drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements, including future system expansion as indicated on Contract Documents.
- B. Verify that system capacities listed in manufacturer instructions align with designed system.
- C. Verify that mounting surfaces are ready to accept components and equipment, with suitable support frames and anchors installed where required.
- D. Verify ratings, configurations, and characteristics of system components.
- E. Verify rough-ins for field connections.
- F. Verify that work likely to damage fire alarm system has been completed.
- G. Verify that interior of building has been protected from weather.
- H. Perform preinstallation tests and inspections per manufacturer's instructions and in accordance with NECA 305.
- I. Verify that system bonding is in accordance with Section 26 05 26.

- J. Do not energize system until deficiencies have been corrected.
- K. Verify that branch circuit wiring installation is completed, tested, and ready for connection to fire alarm system. Overcurrent protection ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

3.02 PREPARATION

- A. Prior to installation, confirm environment of installation area is clean, and with ambient temperature, humidity, and ventilation requirements are per manufacturer's written instructions.
 - 1. Clean and vacuum in accordance with manufacturer's written instructions. Confirm equipment ventilation holes are absent of obstructions and free for air flow.
 - 2. Clean pathways thoroughly to remove foreign materials before installing conductors and cables.
 - 3. Clean dirt, debris, plaster, and other foreign materials from equipment enclosures, cabinets, and outlet boxes.
 - 4. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Follow tool requirements for installation, including torquing adjustments, as listed in manufacturer documentation.
- C. Remove detector dust covers prior to system energization.

3.03 INSTALLATION

- A. Install field-devices, components, FACU and related equipment, and accessories in accordance with the following:
 - 1. Manufacturer's instructions, applicable codes, and Contract Documents.
 - 2. NECA 1.
 - 3. NECA 305.
 - 4. NFPA 72.
 - 5. NFPA 70; including requirements for mechanical execution of work.
- B. Field Locations:
 - 1. Obtain Owner's approval of locations of devices and notification appliances before installation.
 - 2. Arrange equipment to provide minimum operational clearances and required maintenance access in accordance with manufacturer's instructions and NFPA 70.
 - 3. Conceal wiring, conduit, outlet boxes, and supports where installed in finished areas; maintain code-required access.
- C. Raceways and Supports:
 - 1. Coordinate locations of outlet boxes as required for installation. Only install boxes and equipment at locations based on application standards indicated in NFPA 72.
 - a. See Section 26 05 33.16.
 - 2. Secure and support raceways at intervals complying with NFPA 70. Provide supports where vertical rise exceeds permissible limits.
 - a. See Section 26 05 29.
 - 3. Provide minimum of six spare 1-inch trade size conduits out of each fire alarm panel stubbed into accessible space above ceiling.
 - 4. Install firestopping to preserve fire resistance rating of partitions and other elements.
 - a. Minimum height for pathways to pass through floor or wall, if cable fastening is required, and routing in elevator hoistways in accordance with NFPA 70.
 - 5. Provide required vibration isolation or seismic controls.
- D. Wiring and Connections:

1. Maintain separation of Class 1, Class 2, Class 3 remote-control, signaling, fire alarm circuits, and power-limited circuits in accordance with cable insulation class and NFPA 70.
 2. Maintain circuit pathway and class designations in accordance with NFPA 72 for configuration, separation, and survivability.
 3. Comply with permitted and not permitted installations for wires, cables, cable routing assemblies, communications circuits, and fire alarm circuits in accordance with NFPA 70.
 4. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by AHJ. Provide independent support from building structure and suspended ceiling systems. Do not provide support from raceways, piping, ductwork, or other systems.
 5. Provide grounding and bonding in accordance with Section 26 05 26.
 6. Comply with manufacturer's minimum cable sizes or ratings.
 7. Do not exceed manufacturer's recommended maximum power, signal, or network cable lengths between components.
 8. Provide network wiring in accordance with NFPA 70.
 9. Neatly train and bundle conductors inside boxes, wireways, and cabinets.
 10. See manufacturer's instructions for batteries.
- E. Fire Alarm System Components:
1. Install field-installed devices, components, relays, notification appliances, accessories, and when applicable EoL resistors.
 - a. Install wiring to supervisory devices and associated EoL resistors as required for supervision of hardwired connections
 2. Install Wall-Mounted Equipment: Assemble component hardware within (e.g., card bays, sub-bays, expansion bays, signal cards, other card frames, networking, signal transmission, application modules, tamper monitoring devices, interconnecting modules, and auxiliary power supplies), including space for required spare capacity, and configure settings.
 3. Install Interconnect Wiring: Connect system cabinets, install processor and cards, cabling, connectors, terminations, and bonding.
- F. Branch Power:
1. After installation confirmations, follow manufacturer instructions to connect branch circuit power cables to premises fire alarm system components; comply with NFPA 70.
 2. Where accessories require auxiliary power, provide control power source and monitoring as indicated or as required to complete installation.
 3. Install auxiliary power supplies, including indicated monitoring, and connections necessary for remote equipment.
- G. System Identification:
1. Identify devices, notification appliances, components, cables, and equipment in accordance with approved submittals. See Section 26 05 53.
 2. Confirm fire alarm system programming meets requirements of SOO and sub-system SOOs.
 3. Post laminated final SOO and system drawings at FACU.
 4. Mark location of disconnecting means for NPFLA circuits.
 5. Coordinate to provide red branch power circuit protective devices or identify them accordingly as required by NFPA 72 and NFPA 70.
 6. Mark date of batteries installed on inside cover of panels and formal maintenance logs.
- H. Troubleshooting and Installer Checks:
1. Field test connectivity periodically during installation process to avoid unexpected troubleshooting.

2. Check system operation for notification, FACU functions, circuit supervision, alarm initiating devices, supervisory initiating devices, dress panels/doors/covers, and programming before performing field tests.
- I. Fire Alarm System Tests:
 1. Perform required tests of NFPA 72. Record measured values during operational checks.
 2. Confirm functional testing of fire alarm system is as indicated in Contract Documents.

3.04 FIELD QUALITY CONTROL

- A. Provide services of manufacturer's authorized representation to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's detailed testing procedures and field reports and with submittals.
- B. Provide equipment, two-way radios for testing personnel use, tools, and supplies required to accomplish inspection and testing.
- C. Notify Owner and Engineer/Architect at least two weeks prior to scheduled inspections and tests.
- D. Inspect and test in accordance with manufacturer's instructions.
- E. Inspect wiring and components for damage and defects.
- F. Batteries and Power Supplies: Perform inspections and tests listed in manufacturer installation instructions.
- G. Perform additional requirements related to testing and inspection during system startup.
- H. Test for interface with other systems.
- I. Test shunt trips to verify operation.
- J. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.
- K. Submit detailed reports indicated inspection and testing results, corrective actions taken, and as-found and final adjusted settings.
- L. Diagnostic Period: After successful completion of inspections and tests, operate system to normal mode for at least 14 days without system or equipment malfunctions.

3.05 SYSTEM STARTUP

- A. Obtain Owner approval prior to performing system startup.
- B. Manufacturer Services: Provide services of manufacturer's authorized representation to systems startup. Include manufacturer's detailed startup procedures with submittals.
- C. Prepare and start equipment and systems in accordance with manufacturer's instructions and recommendations.

3.06 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust initiating device and notification appliance settings to achieve desired operation as indicated in submittals.
- C. Measure power supply primary and secondary voltages, log values for records, and make appropriate adjustments.
- D. Adjust alignment of equipment covers and doors. Provide keys and spare keys to Owner.
- E. Reprint and reinstall damaged or misinstalled labels; maintain neat and square to installed location good workmanship - see NECA 1; maintain consistent placements for identification on products of similar type.

- F. Adjust devices or notification appliances and associated bases to be flush and level.
- G. Program system parameters according to requirements of Owner.

3.07 CLEANING

- A. Check tightness of electrical connections. Replace damaged components and provide closure plates for vacant positions. Provide circuit directory updates for related power branch circuits.
- B. Clean and repair existing materials and equipment that remain or are indicated for reuse.
- C. Clean dirt, debris, plaster, and other foreign materials from outlet boxes and fire alarm system equipment and components.
- D. Clean fire alarm system equipment and components according to manufacturer's instructions and NECA 305.
- E. Clean surfaces and interiors of boxes and device cover plates in accordance with manufacturer's instructions to remove dirt, fingerprints, debris, plaster, and other foreign materials.
- F. Repair scratched or marred exposed surfaces to match original factory finish.
- G. Comply with federal (EPA), state, and local regulations for battery handling and disposal. Do not spill battery fluids down plumbing drains. Only use containers safe for transportation marked 'nonspillable.'

3.08 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify AHJ and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide services of installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required.
- E. Provide tools, software, and supplies required to accomplish inspection, testing, and document results.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of AHJ; document each inspection and test.
- G. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.
- H. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without system or equipment malfunctions.
 - 1. Record system operations and malfunctions.
 - 2. If malfunction occurs, start diagnostic period over after correction of malfunction.
 - 3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
 - 4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.09 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
- B. Administrative: One-hour session(s) covering issues necessary for nontechnical administrative staff; classroom:

1. Initial Training: One session precloseout.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 1. Initial Training: One session precloseout.
- D. Use operation and maintenance documentation as primary instruction material; have paper copies available for attendees and supplement training material aids.

3.10 CLOSEOUT ACTIVITIES

- A. Closeout Demonstration: Demonstrate operation of all functions to Owner.
 1. Be prepared to conduct any of required tests.
 2. Have minimum one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 3. Have authorized technical representative of FACU manufacturer present during demonstration.
 4. Demonstration may be combined with inspection and testing required by AHJ; notify AHJ with enough time to schedule demonstration.
 5. Repeat demonstration until successful.
- B. Occupancy will not occur prior to Substantial Completion.
- C. Substantial Completion of project cannot be achieved until inspection and testing is successful and the following:
 1. Specified diagnostic period without malfunction has been completed.
 2. Approved operating and maintenance data has been delivered.
 3. Spare parts, extra materials, and tools have been delivered.
 4. All aspects of operation have been demonstrated to Owner.
 5. Final acceptance of fire alarm system has been given by AHJ.
 6. Occupancy permit has been granted.
 7. Specified precloseout instruction is complete.
- D. Perform post-occupancy instruction within three months after Substantial Completion.

3.11 PROTECTION

- A. Protect installed fire alarm system from subsequent construction operations.

3.12 MAINTENANCE

- A. See Division 01, Closeout Requirements for additional requirements relating to maintenance service.
- B. Provide to Owner, at no extra cost, written maintenance contract for entire manufacturer's warranty period, to include work described below.
- C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
 1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 2. Repairs required, unless due to improper use, accidents, or negligence beyond control of maintenance contractor.
 3. Record keeping required by NFPA 72 and AHJ.
- D. Provide trouble call-back service upon notification by Owner:
 1. Provide on-site response within two hours of notification.
 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.

3. Owner will pay for call-back service outside of normal working hours on hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Provide complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with detailed schedule.
- F. Maintain on-site log listing date and time of each inspection and call-back visit, condition of system, nature of trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- G. Comply with Owner's requirements for access to facility and security.

END OF SECTION

SECTION 31 20 01
SITE GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Cut, fill, excavate, backfill, compact and grade the site as necessary to bring the roads, drives, paved areas and open areas to the lines and grades shown on the drawings.
1. The work includes, but is not necessarily limited to:
Excavations and formations of embankments.
Dressing of graded areas, shoulders and ditches.
Roadway, parking area, drive and walk subgrade preparation.
Construction and lining of treatment basins.
 2. Classification: All excavation is unclassified and excavation of every description, regardless of material encountered within the grading limits of the project, shall be performed to the lines and grades indicated.
- B. Related work:
1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in other divisions of these specifications.
 2. Site Clearing and Grubbing.
 3. Trenching, Backfilling for Utilities.
 4. Erosion and Sediment Control.
 5. Storm Drainage System.
- C. Definitions:
1. Open areas: Open areas shall be those areas that do not include building sites, paved areas, street right-of-way and parking areas.
 2. Maximum density: Maximum weight in pounds per cubic foot of a specific material.
 3. Optimum moisture: Percentage of water in a specific material at maximum density.
 4. Rock excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery. To be considered as rock excavation, the material shall be continuous; individual boulders or rocks in soil will not be considered rock excavation.
 5. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be removed by dragline, dredge or other special equipment, are designated as muck. No extra payment will be made for muck removal.
 6. Unsuitable material: Unsuitable material is defined as earth material unsatisfactory for its intended use and as classified by the soils technician. In addition to organic matter, sod, muck, roots and rubbish, highly plastic clay soils of the CH and MH descriptions, and organic soils of the OL and OH descriptions, as defined in the Unified Soil Classification System shall be considered as unsuitable material.
 7. Suitable material: Where the term suitable material is used in specification sections pertaining to earthwork, it means earth or materials designated as being suitable for

their intended use by soils technicians or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, CL or as designated in these specifications.

8. Select material: Select material is defined as granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification types SW, SM, GW or GM or as otherwise approved by the Engineer as select fill. Select material shall contain no stones or rubble larger than 1-1/2" in diameter.
9. Crushed stone (gravel): Crushed stone shall be No. 57 aggregate or equal conforming to ASTM C-33.
10. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered.

D. The Contractor must determine for himself the volume of material required by the site.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with requirements of governmental agencies having jurisdiction.
- C. A testing laboratory retained by the Owner will make such tests as are deemed advisable. The Contractor shall schedule his work so as to permit a reasonable time for testing before placing succeeding lifts of fill material and shall keep the laboratory informed of his progress. The cost of the initial tests shall be paid for by the Owner. Subsequent tests required as a result of improper compaction shall be paid for by the Contractor.

1.3 PRODUCT HANDLING

- A. Comply with pertinent provisions of the contract documents.

1.4 JOB CONDITIONS

- A. Notification of intent to excavate:
 1. South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978) requires persons to ascertain the location of underground public utility property prior to excavation or demolition in certain situations. The Act also requires such persons to give timely notice of intent to excavate or demolish prior to commencing such operations. Failure to comply could subject the violator to a civil penalty of up to one thousand dollars (\$1,000) for each violation of the Act.
 2. Notification of intent to excavate may be given by calling this toll free number: 1-800-922-0983.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Soil material used as fill, backfill, subgrade for structures or pavements, embankments, or site grading shall consist of suitable material as found available on site until such supply of on-site material is depleted.
 - 1. Provide suitable material free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension, and with not more than 15% of the rocks or lumps larger than 2-1/2" in their greatest dimension.
 - 2. Do not permit rocks having a dimension greater than 1" in the upper 6" of fill or embankment.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, suitable borrow material as approved by the Engineer shall be provided by the Contractor at no additional expense to the Owner.
- C. Select materials may be provided from on-site if acceptable material as approved by the Engineer is available on site. Otherwise approved select material shall be provided by the Contractor from an off-site source.

2.2 TOPSOIL

- A. Use topsoil consisting of material removed from the top 3" to 6" of existing on-site soils.
- B. Use topsoil containing no stones, roots or large clods of soil.
- C. Stockpile topsoil separate from other excavated material.

2.3 WEED KILLER

- A. Provide a dry, free-flowing, dust free chemical compound, soluble in water, capable of inhibiting growth of vegetation and approved for use on this work by governmental agencies having jurisdiction.

2.4 EQUIPMENT

- A. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner without undue waste or damage of material.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Clearing and grubbing: Clear and grub areas to be graded prior to commencement of the grading operations.
- B. Where so directed by the Owner, protect and leave standing designated desirable trees.
- C. Complete any demolition and/or removal work as may be required prior to grading operations.
- D. Dispose of all clearing, grubbing and demolition debris and other deleterious material off the project site. Vegetation, roots, brush, rubbish, stumps, etc. may be burned on-site where permitted by local authorities and regulations and approved by the Engineer.
- E. Topsoil: Strip topsoil to a depth of 3" to 6" without contamination from the subsoil and stockpile topsoil separate from other excavated materials.
 - 1. Transport and deposit topsoil in storage piles convenient to areas that are to receive topsoil or in other locations as indicated or approved by the Engineer.
 - 2. Deposit topsoil in areas that are already graded and will not be disturbed by on-going construction.
 - 3. Dispose of unsuitable or unusable stripped material off-site or as otherwise directed by the Engineer.
- F. Sampling and preliminary testing:
 - 1. Prior to beginning the grading operations, the Contractor shall submit to the Engineer his proposed sequence of excavation operations.
 - 2. Based upon the sequence of excavation, samples of the fill materials will be obtained as excavation proceeds and tested for grain size permeability and moisture density relationship using the Standard Proctor Method (ASTM D698, Method A).
 - 3. Allow sufficient time for completion of laboratory tests before any fill operations begin, using the soils being tested.

3.3 FINISH ELEVATIONS AND LINES

- A. Construct areas outside of building or structure lines true to grades shown.
 - 1. Where no grade is indicated, shape finish surface to drain away from buildings or structures, as approved by the Engineer.
- B. Degree of finish shall be that ordinarily obtainable from bladegrader, supplemented with hand raking and finishing.
- C. Finish surfaces to within 0.10' above or below the established grade or approved cross section.

3.4 GENERAL PROCEDURES

- A. Existing utilities:
 - 1. Unless shown to be removed, locate and protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.

2. If active utility lines are encountered and are not shown on the drawings or otherwise made known to the Contractor, promptly notify the Engineer and take necessary steps to assure that service is not interrupted.
 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.
 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.
- B. Protection of persons and property:
1. Barricade open holes and depressions occurring as part of this Work, and post warning lights on property adjacent to or with public access.
 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
- C. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- D. Maintain access to adjacent areas at all times.
- E. Excavate and backfill in a manner and sequence that will provide proper drainage at all times.

3.5 EXCAVATING (CUTS)

- A. Perform excavating of every type of material encountered within the limits of the Work to the lines, grades and elevations indicated and specified herein.
- B. Provide sloping, sheeting, shoring, and bracing for excavations conforming with 29CFR1926 Subpart P-Excavations and the Contract Documents.
- C. Suitable excavated materials:
1. Use all suitable materials removed from the excavation as far as practicable in the formation of the embankments, subgrades, shoulders, building sites and other places as directed.
 2. Surplus suitable materials from excavations shall be wasted on the site as indicated, spreading and leveling as directed.
- D. Unsuitable excavated material: Remove from the site and dispose of all unsuitable material unless otherwise approved by the Engineer.
- E. Rock excavation:
1. Notify the Engineer upon encountering rock or similar material which cannot be removed or excavated by conventional earth moving or ripping equipment.
 2. Do not use explosives without written permission from the Engineer.

3. When explosives are permitted, use only experienced powdermen or persons who are licensed or otherwise authorized to use explosives. Store, handle and use explosives in strict accordance with all regulatory bodies and the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
 4. The Contractor shall be solely responsible for any damage resulting from the use of explosives.
 5. The Contractor is responsible for securing all permits required in performing this work.
- F. Unauthorized excavation:
1. Excavation of material to depths below the grades indicated unless so directed by the Engineer will be deemed unauthorized excavation.
 2. Unauthorized overexcavation shall be backfilled and compacted without any additional expense to the Owner.
- G. Authorized overexcavation:
1. In the event that it is necessary to remove unsuitable material to a depth greater than that shown on the drawings or otherwise specified, the Contractor shall remove, replace and compact such material with suitable material as directed by the Engineer at no additional expense by the Owner.

3.6 FILLING AND BACKFILLING

- A. Use fills formed of suitable material placed in layers of not more than 8" in depth measured loose and rolled and/or vibrated with suitable equipment until compacted.
- B. Do not place rock that will not pass through a 6" diameter ring within the top 12" of the surface of the completed fill or rock that will not pass through a 3" diameter ring within the top 6" of the completed fill.
- C. Do not use broken concrete or asphaltic pavement in fills.
- D. Selection of borrow material:
1. Material in excess of that available on the site shall be suitable material furnished by the Contractor from private sources selected by the Contractor. The material shall be approved by the Engineer before use. All expenses involved in securing, developing, transporting and placing the material shall be borne by the Contractor.
- E. Placing and compacting:
1. Place backfill and fill materials in layers not more than 8" in loose depth.
 2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.
 3. Compact each layer to required percentage of maximum density for the area.
 4. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
 6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structures to approximately the same elevation in each lift.

- F. Moisture control:
1. Do not use soil material that is either too dry or too wet to achieve proper compaction.
 2. Where subgrade or layer of soil material is too dry to achieve proper compaction, uniformly apply water to surface of soil material such that free water does not appear on the surface during or subsequent to compacting operations.
 3. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.
 4. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture-density relation tests approved by the Engineer.
- G. Compaction requirements (where a geotechnical report is supplied, the more stringent requirements shall apply):
1. Compact soils to not less than the following percentages of maximum dry density as determined in accordance with ASTM D698, Method A (Standard Proctor).
 2. Fill beneath roadway:

Top 12" of subgrade	100%
All other fill material	95%
 3. Embankments:

Top 12" of subgrade	98%
All other fill material	95%
 4. Fill beneath walkways:

Top 12" of subgrade	95%
All other fill material	90%
 5. Lawn and unpaved open areas:

All other fill material	90%

3.7 FINISH GRADING

- A. General:
1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.
 2. Smooth the finished surfaces within specified tolerance.
 3. Grade with uniform levels or slopes between points where elevations are shown on the drawings, or between such points and existing grades.
 4. Where a change of slope is indicated on the drawings, construct a rolled transition section having a minimum radius of approximately 8'0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.
- B. Grading adjacent to structures: Grade areas adjacent to buildings to achieve drainage away from the structures and to prevent ponding.
- C. Ditches and gutters and swales:
1. Cut accurately to the cross sections, grades and elevations shown.
 2. Maintain excavations free from detrimental quantities of leaves, sticks, trash and other debris until completion of the work.

3. Dispose of excavated materials as specified herein; do not in any case deposit materials within 3'0" of the edge of a ditch.

3.8 FIELD QUALITY CONTROL

- A. Secure the Engineer's construction review and observation and approval of subgrades and fill layers before subsequent construction is permitted thereon.
- B. Field density determinations will be made, at no cost to the Contractor, to ensure that the specified densities are being obtained. Field density tests will be performed as determined by the Engineer, considering the following:
 1. At areas to receive paving, at least one field density test for every 5,000 sq. ft. of subgrade area, but not less than three tests.
 2. In each compacted fill layer, one field density test for every 5,000 sq. ft. of overlaying paved area, but not less than three tests.
 3. In fill beneath structures, one field density test for every 2,500 sq. ft. in each layer.
 4. Other tests as deemed necessary by the Engineer.
- C. If, in the Engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing until specified requirements are met.
 1. Additional testing will be provided by the Owner's selected testing laboratory and all costs for the additional testing will be borne by the Contractor.
- D. Proofrolling:
 1. The Contractor shall proofroll subgrade of areas to receive paving, structures on fill or impervious lining material.
 - a. Make not less than 3 passes of a 25 to 50 ton rubber tired roller over the full area.
 - b. Unstable, soft or otherwise unsuitable materials revealed by the proofrolling shall be removed and replaced with satisfactory materials, compacted as specified herein.

3.9 PLACING TOPSOIL

- A. Upon completion of site grading and other related site work, topsoil shall be uniformly spread over the graded or improved areas. Topsoil shall be evenly distributed to conform to final grade elevations shown on the plans.
- B. Place, level and lightly compact topsoil to a depth of not less than 3".
- C. Maintain topsoil free of roots, rocks, debris, clods of soil and any other objectionable material which might hinder subsequent grassing or mowing operations.
- D. Any surplus materials shall be removed from the site, unless the owner approves areas on-site for disposal.

3.10 MAINTENANCE

- A. Protection of newly graded areas:

1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
 2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.11 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

SECTION 31 30 02
TRENCHING, BACKFILLING FOR UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Trench, backfill, and compact as specified herein and as needed for installation of underground utilities associated with the Work.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in other divisions of these Specifications.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

1.3 JOB CONDITIONS

- A. Existing utilities:
 - 1. There now exists in the construction areas, waterworks, storm drainage, sanitary sewers, gas mains and other utilities.
 - 2. Approximate location of certain underground lines and structures are shown on the plans for information only, other underground lines or structures are not shown.
 - 3. Locate these and other possible unknown utility lines using electronic pipe finder, or other approved means.
 - 4. Locate, excavate and expose all existing underground lines in advance of trenching operations.
 - 5. The Contractor will be held responsible for the workmanlike repair of any damage done to any of these utilities in the execution of his work under this Section.
 - 6. The Contractor shall familiarize himself with the existing conditions and be prepared to adequately care for and safeguard himself and the Owner from damage.
- B. Notification of intent to excavate:
 - 1. South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978) requires persons to ascertain the location of underground public utility property prior to excavation or demolition in certain situations. The Act also requires such persons to give timely notice of intent to excavate or demolish prior to commencing such operations. Failure to comply could subject the violator to a civil penalty of up to one thousand dollars (\$1,000) for each violation of the Act.
 - 2. Notification of intent to excavate may be given by calling this toll free number: 1-888-721-7877.

- C. Protecting trees, shrubbery and lawns:
 - 1. Trees and shrubbery in developed areas and along the trench line shall not be disturbed unless absolutely necessary, and subject to the approval of the Engineer.
 - a. Any such trees and shrubbery necessary to be removed shall be heeled in and replanted.
 - 2. Where trenches cross private property through established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replacement is approved by the Engineer.
 - a. Topsoil underlying lawn areas shall be removed and kept separate from general excavated materials.
- D. Clearing:
 - 1. Perform all clearing necessary for installation of the complete work.
 - 2. Clearing shall consist of removing all trees, stumps, roots, brush and debris in the rights-of-way obtained for the Work.
 - 3. All timber of merchantable size shall remain the property of the Owner and shall be trimmed and cut in such lengths as directed and stacked along the edge of the right-of-way.
 - 4. All other material, including trimmings from above, shall be completely disposed of in a satisfactory manner.
- E. Removing and resetting fences:
 - 1. Where existing fences must be removed to permit construction of utilities:
 - a. Remove such fences and, as the Work progresses, reset the fences in their original location and condition, unless otherwise shown on the plans.
 - b. Provide temporary fencing or other safeguards as required to prevent stock and cattle from wandering to other lands.
- F. Restoration of disturbed areas:
 - 1. Restore all areas disturbed by, during or as a result of construction activities to their existing or better condition.
 - a. For existing areas with sod type grasses, replace with new sod. Existing sod may be reused where properly removed and stored.
 - 2. Do not interpret this as requiring replacement of trees and undergrowth in undeveloped sections of the rights-of-way.
- G. Minimizing silting and bank erosion during construction:
 - 1. During construction, protective measures shall be taken and maintained to minimize silting and bank erosion of creeks and rivers adjacent to the work being performed during construction.
- H. Blasting is not permitted.

PART 2 - PRODUCTS

2.1 EXCAVATED MATERIALS

- A. Perform all excavation of every description and of whatever substances encountered to depths indicated or specified.
- B. Pile material suitable for backfilling in an orderly manner at safe distance from banks or trenches to avoid overloading and to prevent slides or cave-ins.
- C. Remove and deposit unsuitable or excess materials as directed by the Engineer.

2.2 BACKFILL MATERIALS

- A. Provide from materials excavated for installation of utility.
 - 1. Select soil material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in greatest dimension for backfill up to 12" above top of utility being covered.
 - 2. Do not permit rocks larger than 2" in greatest dimension in top 6" of backfill.

2.3 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, provide suitable borrow material as approved by the Engineer at no additional expense to the Owner.
- C. Provide select materials from on-site if acceptable material as approved by the Engineer is available on-site. Otherwise, provide approved select material from an off-site source.

PART 3 - EXECUTION

3.1 PROCEDURES

- A. Existing utilities:
 - 1. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, repair or replace at no additional cost to the Owner.
 - 2. If active utility lines are encountered and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
 - 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.
 - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.

- B. Locations within streets or highways:
1. Comply with South Carolina Department of Transportation's (SCDOT) "Encroachment Permit" issued for the Work, and the South Carolina Department of Transportation's (SCDOT) "*A Policy for Accommodating Utilities on Highway Rights-of-Way*".
 2. Take all precautions and comply with all requirements as may be necessary to protect the improvements, including barricades for protection of traffic.
 3. Keep minimum of one lane open to traffic at all times where utility crosses street or highway.
- C. Protection of persons and property:
1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
- D. Dewatering:
1. Remove all surface and subsurface waters from excavations and maintain the excavation in a dry condition during construction operations.
 2. Maintain the ground water level a minimum of 3-feet below the trench bottom during excavation, installation and backfilling.
 - a. Material disturbed below the invert elevation due to improper dewatering shall be removed and replaced with crushed stone or lean concrete at no expense to the Owner.
 - b. Use sumps, pumps, drains, trenching, wells, vacuum or well point system as necessary to maintain the ground water level a minimum of 3-feet below the trench bottom and maintain a dry excavation.
 - c. Dewatering by trench pumping will not be permitted if migration of fine grained natural material (running sand) from bottom, side walls or bedding material will occur.
 - d. Provide monitoring wells sufficient in size, location, number and depth to monitor the ground water level in the construction area during excavation and backfill operations.
 - e. Maintain dewatering operations until backfilling and compaction operations are complete.
 3. Water pumped or drained from trenches must be treated by an appropriately sized sediment and erosion control device prior to leaving the site. Discharging untreated or contaminated dewatering effluent is prohibited.
 - a. Contractor is responsible for acquiring all permits required to discharge the water and shall protect waterways from turbidity during the operation.
 - b. Prevent flooding of streets, roadways, or private property.
 - c. Prevent onsite erosion that can be caused by concentrated discharges related to dewatering pumping, drains, or trenching.
 - d. Provide engines driving dewatering pumps with residential type mufflers.
- E. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

- F. Maintain access to adjacent areas at all times.

3.2 TRENCH EXCAVATION (Unclassified)

- A. Provide sloping, sheeting, shoring, and bracing for excavations conforming with 29CFR1926 Subpart P-Excavations and the Contract Documents.
- B. Remove all materials of whatever substance encountered.
- C. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.
- D. Open cut:
 - 1. Excavate for utilities by open cut.
 - 2. If conditions at the site prevent such open cut, and if approved by the Engineer, tunneling may be used.
 - 3. Short sections of a trench may be tunneled if, in the opinion of the Engineer, the conductor can be installed safely and backfill can be compacted properly into such tunnel.
 - 4. Remove boulders and other interfering objects, and backfill voids left by such removals, at no additional cost to the Owner.
 - 5. Remove wet or otherwise unstable soil incapable of properly supporting the utility, as determined by the Engineer, to depth required and backfill to proper grade with stone bedding material, at no additional cost to the Owner.
 - 6. Excavating for appurtenances:
 - a. Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
 - b. Overdepth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as directed by the Engineer, and at no additional cost to the Owner.
- E. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible. Accurately grade the bottom to provide uniform bearing for the utility.
- F. Provide sheeting and shoring necessary for protection of the Work and for the safety of personnel.
 - 1. Remove in units when level of backfilling has reached the elevation necessary to protect the utility work and adjacent property.
 - 2. Sheeting at the bottom of trenches over 10' deep for sewers 15" and larger in size, shall remain in place and be cut off no less than 2" above top of pipe, at no additional cost to the Owner.
- G. Depressions:
 - 1. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.
 - 2. Except where rock is encountered, do not excavate below the depth indicated or specified.

3. Where rock is encountered, excavate rock to a minimum overdepth of 4" below the trench depth indicated or specified, and to provide 6" clearance in any horizontal direction from all parts of the utility and appurtenances.
- H. Special requirements relating to excavation for specific types of utilities shall comply with the following:
1. Electrical conduit:
 - a. Provide depth of cover shown or minimum cover of 36", whichever is greater.
 - b. Where minimum cover only is required, carry excavations to depths necessary to properly grade the conduit on tangents and vertical curves as directed by the Engineer.
 - c. Provide minimum clearance of 12" between conduit and trench wall or sheeting and bracing lines.
 - d. If minimum cover of 36" cannot be provided, then thermoplastic piping may not be used. Use ductile iron piping or other Engineer-approved material.
- I. Comply with pertinent OSHA regulations in regards to the excavation of utilities.

3.3 BACKFILLING

- A. General:
1. Backfill trenches and excavations immediately after the pipes are laid, unless other protection is directed or indicated.
 2. Select and deposit backfill materials with special reference to the future safety of the pipes.
 3. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the Engineer.
 4. Surplus material shall be disposed of as directed by the Engineer.
 5. Original surface shall be restored to the approval of the Engineer.
 6. Maintain proper dewatering during backfill and compaction operations.
- B. Lower portion of trench:
1. Deposit approved backfill and bedding material in layers of 6" maximum thickness, and compact with suitable tampers to the density of the adjacent soil until there is a cover of not less than 24" over sewers and 12" over other utility lines.
 2. Take special care in backfilling and bedding operations not to damage pipe and pipe coatings.
- C. Remainder of trench:
1. Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6" or 1/2 the layered thickness, whichever is smaller, in any dimension.
 2. Deposit backfill material in layers not exceeding the thickness specified, and compact each layer to the minimum density directed by the soil engineer.
- D. Adjacent to buildings: Mechanically compact backfill in 6" layers within ten (10') feet of buildings.

- E. Under roads, streets and other paved areas:
 - 1. Mechanically tamp in 6" layers using heavy duty pneumatic tampers or equal.
 - 2. Tamp each layer to a density equivalent of not less than 100% of an ASTM D 698 Proctor Curve.
 - 3. Provide additional compaction by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone.
 - 4. Refill any settlement with crushed stone and continue such maintenance until replacement of pavement is authorized by the Engineer.
- F. Undeveloped areas:
 - 1. Backfill in wooded, swampy or undeveloped areas shall be as specified hereinbefore, except that tamping of the backfill above a level 2' over the top of the pipe will not be required.
 - 2. Mound excavated material neatly over the ditch to provide for future settlements.

3.4 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

SECTION 31 40 01
EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide protection of the environment during the construction of this project to reduce soil erosion and siltation to the lowest reasonably achievable level.

1.2 GENERAL

- A. Exercise every reasonable precaution, throughout the life of the project, to prevent the eroding of soil and the silting of rivers, streams, lakes, reservoirs, other water impoundments, ground or roadway surfaces, or other property. Erosion control practices to be used for this project are shown on the drawings and are to conform to South Carolina Department of Environmental Services regulations.

PART 2 - PRODUCTS

2.1 CRUSHED STONE

- A. Provide No. 1 aggregate (ASTM C 33) as defined in Section 815 of the SCDOT Standard Specifications for Highway Construction, Latest Edition, for the stabilized construction entrance and exit.
- B. Provide #57 crushed stone for temporary sediment barriers around inlets and for temporary stone check dams.

2.2 GRASSING

- A. Comply with Section 32 92 02 – Grassing for Stabilization.

2.3 SILT FENCE

- A. All posts to be self-fastener angle steel, 5' in length.
 - 1. Wooden posts are not acceptable.
- B. Woven wire shall conform to the requirements of ASTM A 116, Class I zinc coating for wire. Each woven square shall measure 5.33" X 12". The top and bottom wires shall be 10 gauge. All other wires shall be 12-1/2 gauge.
 - 1. Securely attach woven wire to posts with wire ties.
- C. Provide filter fabric meeting the requirements of the South Carolina Department of Environmental Services (SCDES), complying with the most current edition of the SCDOT Standard Specifications for Highway Construction and appearing on the SCDOT Approved Materials Sheet #34.
 - 1. Limit splices in filter fabric using continuous rolls whenever possible.

2. Whenever splices are necessary a minimum overlap of 6" is required and all splices must occur at a post so that the integrity of the fence is not compromised.
 3. Securely attach filter fabric to top of woven wire and at posts with wire ties.
- D. Silt fences should be continuous and transverse to the flow. The silt fence should follow the contours of the site as closely as possible. Place the fence such that the water cannot runoff around the end of the fence.

2.4 EROSION CONTROL BLANKET

- A. Use erosion control blanket S150, from North American Green or approved equal.
1. Use Biostakes where staples are required or indicated on the drawings for stabilization.
 - a. Staple in pattern recommended by blanket manufacturer.
 2. Staple locations must be clearly marked on the blanket when stakes are used.

2.5 RIP-RAP

- A. Comply with Section 31 40 02 - Rip-Rap.

2.6 FILTER FABRIC (Temporary Stone Check Dam)

- A. Use Stablenka Filter Fabric (T-140N), Mirafil (140N) or approved equal.

2.7 SEDIMENT TUBES

- A. Use sediment tubes as designated on the plans to control erosion along contours, around inlets, and in drainage conveyance swales.
- B. Use sediment tubes manufactured by an experienced manufacturer producing tubes for erosion control.
- C. Tube fill is to be composed of 100% weed free materials consisting of a mix of some or all of the following: curled excelsior wood, natural coconut fibers, hardwood mulch and agricultural straw.
- D. Tubular netting is to be constructed of a flexible outer netting that will contain the fill materials and sediment. Netting is to be constructed from seamless high density polyethylene, polyester, and/or ethyl vinyl acetate, photodegradable materials, treated with ultraviolet stabilizers.
- E. Tubes are to be minimum 20-inches in diameter with minimum weight of 3.2 lbs per foot +/- 10%. Minimum tube length is 10-feet. Netting weight is to be 0.35 oz/foot minimum.

PART 3 - EXECUTION

3.1 GENERAL

- A. Construct and maintain all erosion control measures until the substantial completion of the project.

3.2 TEMPORARY CONSTRUCTION ENTRANCE/EXIT

- A. Construct a gravel area or pad at points where vehicles enter and leave a construction site.
- B. Clear the entrance and exit area of all vegetation, roots, and other objectionable material and properly grade and place gravel to the grade and dimensions shown on the plans.
- C. Construct drainage channels to carry water to a sediment trap or other suitable outlet.
- D. Use geotextile fabrics to improve stability of the foundation in locations subject to seepage or high water table.
- E. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site by periodic top dressing with two inches of stone.
- F. After each rainfall, inspect any structure used to trap sediment and clean it out as necessary.
- G. Immediately remove objectionable materials spilled, washed, or tracked onto public roadways.

3.3 TEMPORARY GRASSING

- A. Provide a temporary cover for erosion control on disturbed areas that will remain unstabilized for a period of more than 30 days in accordance with Section 32 92 02.
- B. This practice applies to cleared areas, diversions, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles where vegetation is needed for less than 1 year.
- C. Provide grassing on slope 5% or greater within 14 days of disturbance. Comply with Section 32 92 02.

3.4 SILT FENCE

- A. Provide silt fence barrier where shown on the plans and on utility construction parallel to the disturbed trench where perpendicular sheet flow runoff occurs on disturbed areas with slopes greater than 4%.
- B. Place at the extreme limits of the area to be disturbed as shown.
- C. Construct temporary sediment barriers of filter fabric, buried at the bottom, stretched and supported by posts and install below small disturbed areas as indicated on the drawings to retain sediment by reducing the flow velocity to allow sediment deposition.

- D. Space posts 10'-0" on center, maximum or as indicated on the drawings.
- E. Remove sediment deposits prior to reaching one-third height of the fence.
- F. Monitor site frequently and place additional silt fencing should evidence indicate that erosion is about to occur at locations other than those shown on plan.

3.5 INLET PROTECTION

- A. Construct temporary sediment barriers around storm drain curb inlets using block and gravel as indicated on the drawings.
- B. Construct metal frame barriers around grate and frame of drop inlets as indicated on the drawings.
- C. Inspect structure after each rainfall and repair as required.
- D. Remove sediment when trap reaches one-half capacity.
- E. Remove structure when protected areas have been stabilized.

3.6 EROSION CONTROL BLANKET

- A. Provide on areas as shown on the plans or on all embankments with slopes equal to or steeper than 2-1/2:1.

3.7 TEMPORARY STONE CHECK DAMS

- A. Utilize temporary stone check dams as indicated on the plans or directed by Engineer.
- B. Provide temporary stone check dams constructed of both rip-rap and #57 stone, as illustrated on the plans.

3.8 SEDIMENT TUBES

- A. Construct small U-shaped trench that is 20% of depth of tube perpendicular to stormwater flow pattern.
- B. Anchor tube in trench according to manufacturers recommendations.
- C. Compact the upstream soil surface adjacent to the tube.
- D. Backfill sediment tube with coarse filter material on the upstream side.
- E. Follow manufactures recommendation on installation.
- F. Maintain, repair and/or replace sediment tubes as required to maintain their effectiveness throughout the project

3.9 MAINTENANCE

- A. Place all erosion control devices or measures prior to any land disturbing activity within the drainage area they are located.
- B. Inspect erosion control devices and clean or otherwise remove silt buildup as necessary once a week or 24-hours following a rain event of ≥ 0.1 ".

3.10 REMOVAL

- A. Remove temporary structures after protected areas have been stabilized.

3.11 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the items under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

SECTION 31 40 03
FABRIC UNDERLAY MATERIAL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide stabilization fabric underlay material on existing grade under paving as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 31 20 01 - Site Grading.
 - 3. Section 32 12 17 - Stone Base Course.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

- A. Not Used.
- B. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Certificates, signed by the materials producer and the asphalt paving subcontractor, stating that the materials meet or exceed the specified requirements.

1.4 PRODUCT HANDLING

- A. Not Used.

PART 2 - PRODUCTS

2.1 PROPERTIES

- A. Provide fabric woven from isolactic polypropylene monofilaments, non-biodegradable, resistant to chemicals and treated to withstand exposure to ultraviolet degradation.

- B. Fabric shall have the following properties:

1.	Grab Tensile Strength	315 lb.
2.	Grab Elongation	15%
3.	Mullen Burst Strength	600 psi
4.	Trapezoid Tear Strength	120 lb.
5.	Apparent Opening Size (AOS)	.425 mm 40 (U.S. Sieve)
6.	Permitivity	0.05 Sec ⁻¹
7.	Flow Rate	4.0 gal/min/ft ²
8.	Thickness	25 mils
9.	Weight	6.0 oz./sq. yd.
10.	Ultraviolet Stability	70% @ 500 hours

- C. Fabric underlay material shall be Mirafi 600X or approved equal.

PART 3 - EXECUTION

3.1 EQUIPMENT AND CONSTRUCTION METHODS

- A. Equipment and construction methods shall conform with the requirements of the South Carolina State Highway Department Standard Specifications for Highway Construction, Edition of 2004, Section 305.06 through 305.15, entitled "Construction Requirements", and latest revisions and supplements.

3.2 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the items under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

**SECTION 32 12 16
ASPHALT PAVING**

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Provide asphaltic concrete paving where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these Specifications.
2. Section 31 20 01 - Site Grading.
3. Section 32 12 17 - Stone Base Course.
4. Section 32 17 23 - Pavement Marking and Signage.
5. Section 32 12 20 - Milling, Cutting, and Replacing Pavements.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

A. Not Used.

B. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section.
2. Certificates, signed by the materials producer and the asphalt paving Subcontractor, stating that materials meet or exceed the specified requirements.

1.4 PRODUCT HANDLING

A. Not Used.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and products used shall comply with pertinent sections of the South Carolina Department of Transportation's (SCDOT) "Standard Specifications for Highway Construction" and latest revisions and supplements.

2.2 ASPHALTIC CONCRETE MIXTURE (INTERMEDIATE COURSE)

- A. Materials and composition of mixture shall comply with Section 402 of the SCDOT's "Standard Specifications for Highway Construction" and latest revisions and supplements.
- B. Provide hot plant mixed asphaltic concrete paving materials.
 - 1. Temperature leaving the plant: 290°F minimum, 320°F maximum.
 - 2. Temperature at time of placing: 280°F minimum.

2.3 ASPHALTIC CONCRETE MIXTURE (SURFACE COURSE)

- A. Materials and composition of mixture shall comply with Section 403 of the SCDOT's "Standard Specifications for Highway Construction" and latest revisions and supplements.
- B. Provide hot plant mixed asphaltic concrete paving materials.
 - 1. Temperature leaving the plant: 290°F minimum, 320°F maximum.
 - 2. Temperature at time of placing: 280°F minimum.

2.4 EQUIPMENT

- A. Comply with requirements of Section 401 of SCDOT's "Standard Specifications" and latest revisions and supplements.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
 - 1. Sweep primed surfaces if needed.
 - 2. Adjust frames and covers if needed.

3.2 WEATHER RESTRICTIONS

- A. Do not apply asphalt mixtures to a wet or frozen surface or when air temperature is below 40°F in the shade and falling, or below 35°F in the shade and rising.

3.3 SPREADING AND FINISHING

- A. On arrival at point of use, dump directly into mechanical spreader.
- B. Immediately spread and strike off true to the line, grade and cross section indicated, to such loose depth that when work is completed, the indicated thickness or weight per square yard will be secured.

- C. Correct irregularities while the mixture is still hot.
- D. At locations not readily accessible to mechanical spreaders, acceptable hand spreading methods may be used.
- E. Finished surfaces placed adjacent to curbs, gutters, manholes, etc., shall be approximately 1/4" above the edges of these structures.

3.4 COMPACTION

- A. Perform initial rolling with 3-wheel steel roller or a steel wheel 2-axle tandem roller.
- B. Follow initial rolling with at least four complete coverages by a pneumatic tired roller.
- C. Complete rolling with steel wheel 2-axle tandem roller.
- D. Rolling shall start longitudinally at the sides and proceed gradually toward the center of the pavement, overlapping on successive trips approximately 1/2 the width of the roller.
- E. Use hand or mechanical tampers in areas not accessible to powered rollers.
- F. Surface mixture after compaction shall be smooth and true to the established crown and grade.
- G. Finished paving smoothness tolerance:
 - 1. Free from birdbaths.
 - 2. No deviations greater than 1/8" in 6'.

3.5 PROTECTION OF SURFACE

- A. Allow no traffic on surface until the mixture has hardened sufficiently to prevent distortion.

3.6 FLOOD TEST

- A. Flood the entire asphaltic concrete paved area with water by use of a tank truck or hoses.
- B. If a depression is found where water ponds to a depth of more than 1/8" in 6', fill or otherwise correct to provide proper drainage.
- C. Feather and smooth the edges of fill so that the joint between fill and original surface is invisible.

3.8 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for this work and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

SECTION 32 12 17
STONE BASE COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide crushed stone base (with prime) constructed on the compacted subgrade where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 31 20 01 - Site Grading.
 - 3. Section 32 12 16 - Asphalt Paving.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

- A. Not Used.
- B. Certificates, signed by materials producer, stating that materials meet the specified requirements.

1.4 PRODUCT HANDLING

- A. Not Used.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials and products used shall comply with pertinent sections of the South Carolina Department of Transportation's (SCDOT) "Standard Specifications For Highway Construction," latest edition with revisions and supplements.

2.2 FINE AGGREGATE

- A. All materials and products used shall comply with pertinent sections of the South Carolina Department of Transportation's (SCDOT) "Standard Specifications For Highway Construction," latest edition with revisions and supplements.

2.3 COARSE AGGREGATE

- A. All materials and products used shall comply with pertinent sections of the South Carolina Department of Transportation's (SCDOT) "Standard Specifications For Highway Construction," latest edition with revisions and supplements.

2.4 COMPOSITE MIXTURE

- A. All materials and products used shall comply with pertinent sections of the South Carolina Department of Transportation's (SCDOT) "Standard Specifications For Highway Construction," latest edition with revisions and supplements.

2.5 PRIME ASPHALT

- A. All materials and products used shall comply with pertinent sections of the South Carolina Department of Transportation's (SCDOT) "Standard Specifications For Highway Construction," latest edition with revisions and supplements.
- B. Provide prime coat from a supplier listed on the most recent edition of SCDOT Qualified Product List 38.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

- A. Proofroll all areas to receive crushed stone paving.
 - 1. Make not less than three passes over the full area, using a 35 to 50 ton rubber tired roller.
- B. Remove all soft, unstable or unsuitable material that will not compact readily.
 - 1. Remove to full depth of unsuitable material, or to a depth of 30", whichever is less.
 - 2. Replace with satisfactory materials.
- C. Fill all holes, ruts or depressions which develop in the subgrade with approved on-site material, bringing subgrade to indicated line and grades.
- D. Compact subgrade using suitable construction procedures to provide not less than 95% Standard Proctor Maximum Dry Density.
- E. Seal roll the subgrade surface with a steel wheel roller, sealing the surface against excessive water infiltration.

3.2 PLACING AND MIXING OF PAVING MATERIAL

- A. Place aggregates using spreader boxes or other approved spreaders uniformly on one operation.
- B. Take care to avoid segregation of the fine from the coarse aggregate during handling, spreading or shaping operations.

- C. Mix, while at proper moisture, with motor grader or other equipment and maintain to required section and grade until thoroughly compacted.

3.3 ROLLING AND COMPACTING

- A. Perform using 3-wheel steel wheel roller weighing not less than 10 tons, tandem roller weighing at least 8 tons, or other rollers approved by the Engineer.
- B. Start rolling at edges and proceed toward the center, continue rolling until aggregates are firmly keyed or set.
- C. When initial compaction is completed, should voids remain, place fine aggregates on the surface in an amount only sufficient to fill the voids.
- D. Broom, wet and roll until coarse aggregate is set, bonded and thoroughly compacted for full width and depth.
- E. Compact stone base course to provide not less than 100% Modified Proctor Maximum Dry Density.

3.4 ALLOWABLE TOLERANCES

- A. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 1/2".
 - 1. Depth measurements will be made by digging through the base at intervals no closer than 250', nor greater than 500' apart.
 - 2. Where thickness is less than depth specified minus 1/2", it shall be corrected as directed by the Engineer.
- B. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 3/8" in 10', parallel to the center line of the roadway nor more than 1/2" from a template conforming to the cross sections shown on the plans.
- C. Deviations: Correct by removing materials, replacing with new materials, and reworking or recompacting as required.

3.5 PLACING PRIME COAT

- A. Allow base course to season sufficiently to permit uniform penetration.
- B. Do not apply to wet surfaces or when the temperature is below 60°F in the shade and falling, or below 55°F in the shade and rising.
- C. Clean surfaces of all dust, dirt, clay, etc. using mechanical brooms, etc.
- D. Apply prime material, using pneumatic mounted distributors, at a rate of 0.25 to 0.30 gallon per square yard.
- E. Permit no traffic on primed surfaces until bituminous material has penetrated and dried sufficiently that it does not pick up under traffic.

3.6 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for this work and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

SECTION 32 12 20
MILLING, CUTTING AND REPLACING PAVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Milling, cutting and replacement of existing pavements for installation of utility lines, as specified herein, and as needed for a complete and proper installation of transitions to existing pavement at project boundaries.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these specifications.
 - 2. Section 31 30 02 - Trenching, Backfilling for Utilities.
 - 3. Section 32 12 16 - Asphalt Paving.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods for proper performance of the work of this Section.

1.3 SUBMITTALS

- A. Not Used.

1.4 PRODUCT HANDLING

- A. Not Used.

1.5 WARRANTY

- A. All remove and replace pavement work shall be warranted for two years beginning on the date of acceptance by the Owner.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Comply with Section 03 30 00, using strength specified herein.

2.2 ASPHALTIC CONCRETE

- A. Comply with Section 32 12 16.

2.3 AGGREGATE BASE COURSE WITH PRIME

- A. Comply with Sections 32 12 16 and 32 12 17.

PART 3 - EXECUTION

3.1 GENERAL

- A. Remove to neat lines and dispose of as directed.
- B. Replace with bases and pavements as required by Sections 32 12 16 and 32 12 17 and the Construction Plans.

3.2 CUTTING

- A. Asphalt pavement or base:
 - 1. Cut on straight and true lines, to a minimum depth of 2", using powered concrete saw.
 - 2. Shear off remaining depth with pneumatic tools.
- B. Concrete sidewalks shall be removed back to the nearest joint on each side of the crossing.
- C. Cut to straight and true lines with powered concrete saw.

3.3 MILLING

- A. Use self-propelled milling equipment capable of maintaining accurate cut depth and slope and providing smooth cut edges.
- B. Ensure the equipment can accurately and adequately establish profile grade and control cross slope.
- C. Equip the milling machine with integral material pickup and truck discharges.
- D. Ensure the milling machine has effective means for dust control.
- E. Material size to comply with SCDOT specifications.
- F. All asphalt pavement designated for milling, unless otherwise provided, must be disposed of by the Contractor at no additional cost to the Owner.

3.4 REPLACEMENT

- A. Concrete sidewalks:
 - 1. Replace with 4000 psi concrete.
 - 2. Depth shall be equal to existing section removed, but not less than 4".
 - 3. Finish surface to match existing sidewalk.

- B. Flexible pavements:

1. Compact subgrade according to Section 31 10 01.
2. Undercut each edge 6" to form a shelf.
3. Reconstruct roadway according to details shown on the Construction Plans.
4. Taper resurfacing to existing pavement evenly for a distance of 50 feet beyond repaired area, or as shown on the Construction Plans.
5. Comply with Section 32 12 16.

3.7 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for the work under this section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete sidewalks.
2. Concrete integral curbs and gutters.
3. Concrete median barriers.
4. Concrete base and surface for parking areas and roads.
5. Small miscellaneous slabs.

B. Related Sections:

1. Section 31 23 16 - Excavation and Fill: Compacted subgrade for paving.
2. Section 32 11 23 - Aggregate Base Courses: Compacted base for paving.
3. Section 32 12 16 - Asphalt Paving: Asphalt wearing course.
4. Section 32 17 23 - Pavement Markings.
5. Section 33 05 61 - Concrete Manholes: Frames and lids in paving.

1.2 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO)

1. AASHTO M 31 – Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
2. AASHTO M 32 – Standard Specification for Steel Wire, Plain for Concrete Reinforcement.
3. AASHTO M 148 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
4. AASHTO M 282 – Standard Specification for Joint Sealants, Hot Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

C. ASTM International:

1. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
2. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
3. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

5. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
6. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
7. ASTM D3406 – Standard Specification for Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.

D. SCDOT Standard Specifications:

1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals
- B. Concrete Mix Design: Submit concrete mix design 30 days prior to use of concrete.
- C. Product Data: Submit data on joint materials, admixtures, and curing compounds.
- D. Manufacturer's Certification: Certify products are produced at a plant approved by SCDOT and that products meet or exceed specified requirements.
- E. Installer Certification: Certify installer is on list of SCDOT prequalified contractors with an approved Quality Control Plan.
- F. Process Control Plan: Submit process control plan for delivering and placing concrete.
- G. Samples: Submit two sample panels, 2 inch x 12 inch in size, illustrating exposed aggregate finish.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with SCDOT Standard Specifications, except as modified herein.
- B. Maintain one copy of document on site.
- C. Obtain cementitious materials from same source throughout.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section and prequalified by SCDOT.
- B. Installer: Company specializing in performing Work of this Section and prequalified by SCDOT.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Instructions to Bidders: Environmental conditions affecting products on site.

- B. Do not place concrete when base surface temperature or air temperature in the shade is 40 degrees F and falling or surface is wet or frozen.
- C. Do not place concrete when air temperature in the shade is 95 degrees F and rising or when concrete temperature is greater than 95 degrees F.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Slip Form Methods: Use slip form methods wherever possible.
- B. Fixed Form Materials: Metal conforming to SCDOT Standard Specifications.

2.2 JOINT MATERIALS

- A. General: Conform to SCDOT Standard Specifications.
- B. Joint Filler: Sponge rubber or cork type conforming to ASTM D1751 (AASHTO M213) or bituminous, non-extruding, resilient type conforming to ASTM D1752 (AASHTO M153), Type 1; thickness as indicated on Drawings.
- C. Silicone Sealant: Low modulus, cold applied, single component, chemically curing silicone material.
 - 1. Type NS: Non-sag silicone, toolable.
 - 2. Type SL: Self-leveling silicone, tooling not required.
- D. Rubber Asphalt Sealant: Hot poured rubber asphalt joint sealer conforming to AASHTO M282 (ASTM D3406).
- E. Bond Breaker:
 - 1. General: Product that does not stain or adhere to the sealant and is chemically inert and resistant to oils, gasoline, solvents, and primer.
 - 2. For On-Grade Pavements: Circular backer rod, diameter 25 percent larger than joint width.
 - a. Type L, For Cold Pour Sealants Only: Closed cell expanded polyethylene foam. Use with Type NS silicone only.
 - b. Type M, For Cold or Hot Pour Sealants: Closed cell polyolefin with closed skin over an open cell core.
 - 3. For Bridge Decks Only: Bond breaking tape, extruded polyethylene with pressure sensitive adhesive on one side, minimum 0.005 inches thick.

2.3 REINFORCEMENT

- A. General: Conform SCDOT latest edition Standard Specifications.
- B. Reinforcing Steel: ASTM A615 (AASHTO M 31); 60 ksi yield grade; deformed billet steel bars; epoxy coated finish.

C. Dowels and Tie Bars: ASTM A615 (AASHTO M 31); 60 ksi yield grade, plain steel, epoxy coated finish.

D. Welded Wire Fabric Steel: Deformed type, ASTM A497; unfinished.

2.4 CONCRETE MATERIALS

A. Concrete Materials: Provide fine aggregate, coarse aggregate, Portland Cement, fly ash, ground granulated blast furnace slag, water, air entraining agent, and chemical admixtures in accordance with SCDOT Standard Specifications.

2.5 ACCESSORIES

A. Curing Compound: ASTM C309 (AASHTO M-148), Type 1 clear or translucent or Type 2 white pigmented.

2.6 CONCRETE MIX

A. Mix and deliver concrete in accordance with SCDOT Standard Specifications.

B. Roadway and Area Pavement concrete: Air entrained conforming to the following criteria:

1. Flexural Strength: 650 psi at 28 days.
2. Slump: 1.5 inch maximum for slip form method, 3 inches maximum for fixed form hand methods.
3. Minimum Cement Content: 526 pounds/cubic yard.
4. Maximum Water/Cement Ratio: 0.559.
5. Air Entrainment: Between 4.5 and 5.5 percent.

C. Class A Concrete for sidewalk, curb, curb and gutter, and other incidental site concrete: Air entrained, vibrated conforming to the following criteria:

1. Compressive Strength: 3,000 psi at 28 days.
2. Maximum Slump Vibrated: 3.5 inches.
3. Minimum Cement Content: 564 pounds/cubic yard.
4. Maximum Water/Cement Ratio for Angular Aggregate: 0.532.
5. Maximum Water/Cement Ratio for Rounded Aggregate: 0.488.
6. Air Entrainment: 6.0 percent plus or minus 1.5 percent.

D. Use accelerating admixtures in cold weather only when approved by the Engineer in writing. Use of admixtures will not relax cold weather placement requirements.

E. Use calcium chloride only when approved by the Engineer in writing.

F. Use set retarding admixtures during hot weather only when approved by the Engineer in writing.

2.7 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services.

- B. Submit proposed mix design of each class of concrete to independent firm for review prior to commencement of Work.
- C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.
- D. Test samples in accordance with ACI 301 for compressive strength (cylinders) and flexural strength (beams.)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify compacted base course is acceptable and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Verify utility structure frames and lids are installed in correct position and elevation.

3.2 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole, catch basin, and other utility structure frames with oil to prevent bond with concrete pavement.
- C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 REINFORCEMENT

- A. Place reinforcement as indicated on Drawings.
- B. Interrupt reinforcement at contraction and expansion joints.
- C. Place dowels to achieve pavement and curb alignment as detailed.

- D. Provide doweled joints 18 inches on center at transverse joints with one end of dowel set in capped sleeve to allow longitudinal movement.

3.5 PLACING CONCRETE

- A. Place concrete in accordance with SCDOT Standard Specifications.
- B. Place concrete using the slip form technique wherever possible.
- C. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- E. Place concrete to pattern indicated on Drawings.

3.6 PAVEMENT JOINTS

- A. Provide expansion, contraction, and construction joints as indicated on Drawings.
- B. Place expansion joints at 60 foot maximum intervals. Place contraction joints at 20-foot maximum intervals. Align pavement joints with curb, gutter, and sidewalk joints.
- C. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/2 inch for backer rod and sealant placement.
- D. Saw cut contraction joints 3/16 inch wide or as indicated at an optimum time after finishing. Cut 1/3 into depth of slab.

3.7 SIDEWALK, CURB, AND CURB AND GUTTER JOINTS

- A. Provide sawn joints at 5-foot intervals. Provide 3/4 inch expansion joint at 30 feet maximum and between sidewalks and curbs and structures.
- B. Align sidewalk, curb and gutter joints with pavement joints.

3.8 FINISHING

- A. Area Paving: Heavy broom.
- B. Sidewalk Paving: Light broom. [Brush to 6 inch radius with smooth trowel joint edges.]
- C. Median Barrier: Light broom and trowel joint edges.
- D. Curbs and Gutters: Light broom.
- E. Inclined Vehicular Ramps: V-grooves with mechanical equipment and spring tines, perpendicular to slope.

3.9 EXPOSED AGGREGATE

- A. Apply surface retarder where exposed aggregate finish is indicated.
- B. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush exposing aggregate to match sample panel.
- C. Sand blast concrete surfaces to achieve aggregate exposure surface to match sample panel.

3.10 CURING

- A. Place curing compound on concrete surfaces immediately after finishing.
- B. Cover with burlap or polyethylene film to protect from cold weather and rain.

3.11 JOINT SEALING

- A. Separate pavement from vertical surfaces with 1/2 inch thick joint filler.
- B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- C. Extend joint filler from bottom of pavement to within 1/2 inch of finished surface.

3.12 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 feet.
- B. Maximum Variation From True Position: 1/2 inch.
- C. Maximum Variation in thickness: 1/2 inch.

3.13 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Prepare three concrete test beams for every 1,333 or less square yards of pavement for each class of concrete placed each day.
- C. Prepare one additional test beam during cold weather and cured on site under same conditions as concrete it represents.
- D. One slump test will be taken for each set of test cylinders taken.
- E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.
- F. Take one 4-inch diameter core for every 1,333 square yards or less of pavement for each class of concrete placed each day.

3.14 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian or vehicular traffic over pavement for 7 days minimum after finishing.

3.15 SCHEDULES

- A. Concrete Sidewalks: Class A Concrete, compressive strength of 4,000 psi at 28 days, 4 inches thick, buff color Portland cement, light broom finish.
- B. Roadway Pavement Concrete: Non-reinforced, flexural strength of 650 psi at 28 days, 8 inches thick, wood float finish.
- C. Propane Tank Slab: Class AA Concrete, 4,500 psi 28 day concrete, 6 inches thick, , 6/6 - 6 x 6 inch mesh reinforcement, light broom finish.

END OF SECTION

SECTION 32 91 19
LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Final grade topsoil for finish landscaping.
 - 2. Testing Topsoil.
 - 3. Supplying Topsoil.
 - 4. Scarifying substrate surface.
 - 5. Placing and lightly compacting topsoil.
 - 6. Removing excess topsoil from site.
- B. Related Sections:
 - 1. Section 31 20 01 - Excavation and Fill: Cutting and filling to site subgrade.
 - 2. Section 31 23 16.13 - Trenching: Backfilling trenches to subgrade.
 - 3. Section 32 92 02 – Grassing for Stabilization.
 - 4. Section 32 93 00 - Plants: Topsoil fill for trees, plants and ground cover.

1.2 REFERENCES

- A. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Test Results: Submit results of topsoil tests to determine soil amendments required.
- C. Samples: Submit to testing laboratory for independent test, in air-tight containers, 10 pound sample of topsoil.
- D. Materials Source: Submit name and location of imported materials source.

1.4 QUALITY ASSURANCE

- A. Furnish each topsoil material from single source throughout the Work.
- B. Perform Work in accordance with applicable portions of SCDOT Standard Specifications for Highway Construction, latest edition, published by SC Department of Transportation.
- C. Maintain one copy on site.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.
- B. Suitable material excavated from site, amended per requirements of tests is acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify building and trench backfilling have been inspected.
- C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove contaminated subsoil.
- C. Scarify surface to depth of 6 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

- A. Place topsoil in areas where seeding, sodding, and planting is required to thickness as scheduled. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to plant material, buildings, and pavement to prevent damage.
- E. Lightly compact placed topsoil.

- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Prohibit construction traffic over topsoil. Scarify and regrade disturbed areas.

3.7 SCHEDULES

- A. Compacted topsoil thicknesses:
 - 1. Seeded Areas: 6 inches.
 - 2. Sodded Areas: 4 inches.
 - 3. Shrub Beds: 18 inches.
 - 4. Flower Beds: 12 inches.
 - 5. Planter Boxes: To within 3 inches of box rim.
 - 6. Trees: As indicated on Drawings.

END OF SECTION

SECTION 32 92 02
GRASSING FOR STABILIZATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide grassing of the areas specified herein, or as indicated, for a complete and proper installation.
 - 1. All cleared areas and areas disturbed by the construction operation not stabilized by field turf.
- B. Related work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in other divisions of these Specifications.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Seed: Conform to all State laws and to all requirements and regulations of the South Carolina Department of Agriculture.
 - 1. Deliver to site each variety of seed individually packaged and tagged to show name, net weight, origin, and lot number.
- C. Fertilizer: Conform to State fertilizer law.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of the contract documents.
- B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Complete materials list of items proposed to be provided under this Section.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of the contract documents.
- B. At time of delivery, furnish the Engineer invoices of all materials received in order that application rates may be determined.
- C. Immediately remove from the site materials that do not comply with the specified requirements, and promptly replace with materials meeting the specified requirements.

PART 2 - PRODUCTS

2.1 FERTILIZER

- A. Provide commercial balanced 16-4-12 or 12-4-8 fertilizer delivered to the site in bags labeled with the manufacturer's guaranteed analysis.

2.2 GRASS SEED

- A. Provide grass seed that is:
 - 1. Free from noxious weed seeds, and recleaned.
 - 2. Grade A recent crop seed.
 - 3. Treated with appropriate fungicide at time of mixing.
 - 4. Delivered to the site in sealed containers with dealer's guaranteed analysis.

2.3 LIME

- A. Provide agricultural grade, standard ground limestone conforming to current "Rules, Regulations and Standards of the Fertilizer Board of Control" issued at Clemson University.
- B. Bag tags or delivery slip for bulk loads shall indicate brand or trade name, calcium carbonate equivalent, and other pertinent data to identify the lime.

2.4 WOOD CELLULOSE FIBER

- A. Provide wood chip particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer.
- B. Material to be heat processed so as to contain no germination or growth inhibiting factors.
- C. It shall be dyed (non-toxic) an appropriate color to facilitate metering.

2.5 STRAW MULCH

- A. Provide straw or hay material.
 - 1. Straw to be stalks of wheat, rye, barley or oats.
 - 2. Hay to be timothy, peavine, alfalfa, or coastal bermuda.
- B. Material to be reasonably dry and reasonably free from mature seed bearing stalks, roots, or bulblets or Johnson Grass, Nutgrass, Wild Onion and other noxious weeds.

2.6 EXCELSIOR FIBER MULCH

- A. To consist of 4" to 6", average length, wood fibers cut from sound, green timber.
- B. Make cut in such a manner as to provide maximum strength of fiber, but at a slight angle to natural grain of the wood.

2.7 EROSION CONTROL BLANKET

- A. Provide on areas as shown on the plans.
- B. Provide Erosion Control Blanket S150, from North American Green, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Seed these areas immediately upon completion of grading or construction and clean-up operations.
 - 1. Slopes greater than four horizontal to one vertical.
 - 2. Utility rights-of-way adjacent to stream banks.
- B. Areas ready for planting between August 16 and February 28 shall be planted with a temporary cover of Schedule No. 2. At the acceptable seasons for planting Schedule No. 1, the turf shall be destroyed by reworking the soil, and Schedule No. 1 seeding established as specified herein.
- C. Use Rate A lbs. per 1000 sq. ft. on slopes over 5' horizontal to 1' vertical in height and use Rate B lbs. per 1000 sq. ft. on slopes less than 5' horizontal to 1' vertical.

3.2 SEEDING SCHEDULES (See Plans)

- A. Mixtures of different types of seed for the various schedules shall be weighed and mixed in proper proportions in the presence of the Engineer.
- B. Schedule No. 1 - Planting dates March 1 to August 15:

<u>Common Name of Seed</u>	<u>Rate A</u>	<u>Rate B</u>
Rye Grain	1	1
Common Bermuda (hulled)	0	1.5
Sericea Lespedeza (clay soils)	1	0
Weeping Love Grass (sandy soils)	1	0
Centipede	0.5	0.5

- C. Schedule No. 2 - Planting dates August 16 - February 28:

<u>Common Name of Seed</u>	<u>Rate A</u>	<u>Rate B</u>
Rye Grain	0	1
Common Bermuda (hulled)	0	1.5
Brown Top Millet	5	0
Common Bermuda (unhulled)	0	2.0

3.3 GROUND PREPARATION

- A. Bring all areas to proper line, grade and cross section indicated on the plans.
- B. Repair erosion damage prior to commencing seeding operations.
- C. Loosen seed bed to minimum depth of 3".
- D. Provide and prepare topsoil in accordance with Section 329119.
- E. Conduct soil test to determine pH factor.
 - 1. If pH is not in the range of 6.0 to 6.5, adjust.

3.4 APPLICATION OF FERTILIZER

- A. Spread uniformly over areas to be seeded at:
 - 1. Rate of 18 lbs. per 1000 sq. ft. when using 16-4-12.
 - 2. Rate of 25 lbs. per 1000 sq. ft. when using 12-4-8.
 - 3. Use approved mechanical spreaders.
- B. Mix with soil to depth of approximately 3".

3.5 SOWING METHODS

- A. General:
 - 1. Perform seeding during the periods and at the rates specified in the seeding schedules.
 - 2. Do not conduct seeding work when ground is frozen or excessively wet.
 - 3. Produce satisfactory stand of grass regardless of period of the year the Work is performed.
- B. Seeding, slopes less than four horizontal to one vertical:
 - 1. Shall conform to Methods EA, WF or WCF as specified hereinafter.
 - 2. Method EA (Emulsified Asphalt):
 - a. Sow seed not more than 24 hours after application of fertilizer.
 - b. Use mechanical seed drills on accessible areas, rotary hand seeders, power sprayers, etc. may be used on steep slopes or areas not accessible to seed drills.
 - c. Cover seed and lightly compact with cultipacker if seed drill does not.
 - d. Within 24 hours following compaction of seeded areas, uniformly apply 0.2 gallons per square yard of emulsified asphalt over the seeded area.
 - 3. Method WF:
 - a. Sow seed as specified for Method EA.
 - b. Within 24 hours following covering of seeds, uniformly apply excelsior fiber at the rate of 100 lbs. per 1000 sq. ft.
 - c. Apply material hydraulically.
 - d. Seeded areas to be lightly rolled to form a tight mat of the excelsior fibers.
 - 4. Method WCF:
 - a. Apply seed, fertilizer and wood fiber mulch using hydraulic equipment.

- b. Equipment to have built-in agitation system with capacity to agitate, suspend and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed and water.
 - c. Minimum capacity of slurry tank: 1000 gallons.
 - d. Apply fiber mulch at rate of 35 lbs. per 1000 sq. ft.
 - e. Regulate slurry mixture so that amounts and rates of application will result in uniform application of all materials at not less than the specified amounts.
 - f. Apply slurry in a sweeping motion, in an arched stream, so as to fall like rain, allowing the wood fibers to build upon each other.
 - g. Use color of wood pulp as guide, spraying the prepared seed bed until a uniform visible coat is obtained.
- C. Seeding, slopes greater than four horizontal to one vertical:
- 1. Sow seed as specified for Method EA, unmulched.
 - 2. Cover seeded area with erosion control blanket.

3.6 SECOND APPLICATION OF FERTILIZER

- A. When plants are established and showing satisfactory growth, apply nitrogen at the rate of 1.0 lb. per 1000 sq. ft.
- B. Apply in dry form unless otherwise directed by the Engineer.
- C. Do not apply to stands of temporary grasses.

3.7 MAINTENANCE

- A. Maintain all seeded areas in satisfactory condition until final acceptance of the Work.
- B. Areas not showing satisfactory evidence of germination within six weeks of the seeding date shall be immediately reseeded, fertilized and/or mulched.
- C. Repair any eroded areas.
- D. Mow as necessary to maintain healthy growth rate until final acceptance of the Work.

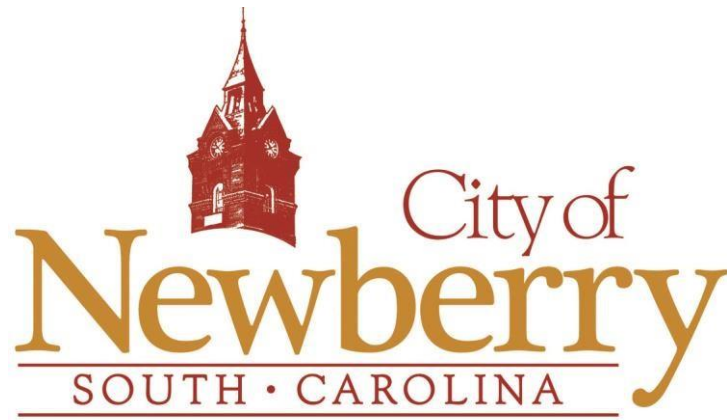
3.8 ACCEPTANCE

- A. Permanently seeded areas (Schedule No. 1) will be accepted when the grass attains a height of 2".
- B. No acceptance will be made of temporary seeded areas (Schedule No. 2). Rework and seed with Schedule No. 1.

3.9 MEASUREMENT AND PAYMENT

- A. No measurement and payment will be made for the work under this Section and all costs for same shall be included in the lump sum price bid for the project.

END OF SECTION



City of Newberry
Water/Sewer Specs.

SECTION 02660

WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide water distribution system as shown on the Drawings, specified herein, and needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
 - 2. Section 02221 - Trenching, Backfilling for Utilities.
 - 3. Section 02615 - Removing and Replacing Pavements.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. All materials in this Section are to be manufactured in the United States.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01640.
- B. Shipment of pipe:
 - 1. Protect pipe with tarp or other means during shipment to prevent truck exhaust from damaging pipe.
- C. Storage of PVC pipe:

1. Store in unit packages as received from manufacturer until just prior to use.
 2. Stack units in such manner as to prevent deformation to pipe barrel and bells.
 3. Protect from direct sunlight by covering with opaque material if storage period will exceed six weeks.
- D. Avoid severe impact blows, gouging or cutting by metal surfaces or rocks.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Use any pipe material and associated fittings as specified herein, except where use of a particular material is indicated on the plans, or specified herein.

2.2 PIPE AND FITTINGS

A. General:

1. Pipe sizes 3" and larger: Use ductile iron or plastic pipes unless otherwise indicated.
No asbestos cement pipe allowed.
 2. Pipe less than 3" size: Use plastic pipe. If under road way use HDPE pipe.
 3. Any pipe, solder, or flux used shall be lead free (lead free is defined as less than 0.2% lead in solder or flux and less than 8.0% lead in pipes and fittings).
 4. Gaskets are to be factory-installed and integral with the pipe.
 5. All pipe 4" and larger shall be National Sanitary Foundation (NSF) approved and shall be third party certified as meeting the specifications of ANSI/NSF Standard 61.
 6. All materials and products that contact potable water shall be third party certified as meeting the specifications of ANSI/NSF Standard 61.
 7. All chemical or products added to the public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60.
 8. For *valves* cast all markings integral on the *valve* body with the size of *valve*, year of manufacture and the class working pressure.
 - a. Certifications to rate a 1508 *valve* body to a Class 250 *valve* will not be acceptable.
 9. For *valves* spray coat all interior wetted ferrous surfaces with two-component epoxy applied to a nominal thickness of 3 to 4 mils.
 - a. Coating material to be AWWA and U.S. Food and Drug Administration approved for use with potable water.
8. Pipe:
1. Ductile iron pipe (DIP):
 - a. Comply with ANSI/AWWA C150/A21.50 or AWWA C151/A21.51, latest revision.

- b. The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.
- c. Wall thickness in accordance with Table 50.5 of ANSI/AWWA C150/A21.50, depth of cover indicated and Type 3 bedding conditions, minimum Pressure Class (Choose pressure rating) as follows:
 - 4" - 12" Pressure Class 350

WATER DISTRIBUTION SYSTEM

- d. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.
2. Plastic pipe (PVC):
 - a. General:
 - 1) Marked with National Sanitation Foundation approval at 18" intervals.
 - 2) Gaskets to comply with ASTM F 477.
 - a) Natural rubber gaskets are not acceptable.
 - b. 4" - 12": Comply with ANSI/AWWA C900, Table 2, Pressure Class 150 (DR18).
 - c. Plastic pipe 3" and smaller: Comply with ASTM D 2241 for PVC 1120, SDR 21. 3" and below.
3. Polyethylene (PE) pipe:
 - a. Comply with AWWA C-906, DR 9 and working pressure of 200 psi.
 - b. The pipe supplied under this Specification shall be SDR high performance, high molecular weight, high density polyethylene pipe, and shall conform to ASTM D 1248 (Type III C, Category 5, P34). Minimum cell classifications values shall be 345434C as referenced in ASTM D 3350 - latest edition. All pipe resin shall be manufactured by the same company that manufactures the pipe itself, in accordance with these specifications, to ensure complete resin compatibility and total product accountability. The fittings supplied in this specification shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe. To ensure compatibility of polyethylene resins, all fittings supplied under this specification shall be of the same manufacture as the pipe being supplied.
 - c. Physical properties:
 - 1) The pipe shall conform to the physical properties as described herein.
 - 2) Typical pipe physical properties:

<u>Property</u>	<u>Test Method</u>	<u>Unit</u>	<u>Value</u>
Density	ASTM Method	gms/cc	0.955
Melt Index	ASTM D-1238 (190/2.16)	gms/10 min	

Environmental Stress Cracking Resistance:

Condition A, B, & C, F-0	ASTM D 1693	hrs	>5000**
Compressed Ring, F-60	ASTM F 1248	hrs psi	>1500
Tensile Strength, Yield	ASTM D 638		3200
Type IV Specimen	(2"/min)		
Elongation at Break	ASTM D 638	%	>750
Type IV Specimen	(2"/min)		
Victate Softening Temp	ASTM D 1525	OF	257
Brittleness Temp	ASTM D 746	OF	<-180
Flexural Modulus	ASTM D 790	psi	135,000

Modulus of Elasticity	ASTM D 638	psi	130,000
Hardness	ASTM D 2240	Shore D	65
Linear Thermal Expansion Coef.	ASTM D 696	in./in./°F	1.2x10-4

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Thermal Conductivity	Dynatech-Colora BTU, In./Thermoconductor ft./2hrs/°F		2.7

Long Term Strength:

73° F	ASTM D 2837	psi	1600
UV Stabilizer	ASTM D 1603	%C	2.5
Material Cell Classification	ASTM D 1248		345434C
Material Description	PPI Recommendation		PE 3408

d. Quality control:

1.) The resin used for manufacture of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index, and other physical properties. The polyethylene resin used shall have all ingredients pre-compound prior to extrusion of pipe, in plant blending is not acceptable. Owner may request, as part of the quality control records submittal, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from manufacturer's testing or random sampling by the Engineer that do not meet appropriate ASTM standards or manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9. Certified lab data may be requested to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.

e. Rejection: The Owner reserves the right to reject any polyethylene pipe and fittings failing to meet any of the requirements of this specification.

f. Pipe dimensions: Pipe supplied under this specification shall have a nominal DIP (ductile iron pipe) size O.D. unless otherwise specified. The DR (Dimension Ratio) of the pipe supplied shall be as specified.

C. Joints:

1. Ductile iron pipe:

a. Use mechanical or push-on joints complying with ANSI/AWWA C111/A21.11 as modified by ANSI/AWWA C151/A21.51.

- b. Use gaskets and lubricant complying with ANSI/AWWA C111/A21.11. Natural rubber gaskets are not acceptable.
- c. Lubricants shall be compatible with pipe and gasket materials, shall not support bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints.
 - 1) NSF approved.

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- d. Exposed pipe:
 - 1) Class 53 minimum.
 - 2) Use flanged joints complying with ANSI/AWWA C115/A21.11, latest revision; and
 - i) Flanges to be solid type.
 - ii) Use full face, red rubber, factory cut, 1/16" thick for pipe up to 10" diameter and 1/8" thick for larger sizes.
 - iii) Bolts and nuts shall be standard carbon steel machine bolts, hex head complying with ANSI A21.11/AWWA C111.
- 2. Plastic pipe:
 - a. Use integral bell or coupling type with elastomeric gaskets.
 - b. Integral bells to comply with ASTM D2672.
 - c. Couplings to comply with ANSI/AWWA C900.
 - d. Gaskets to comply with ASTM F477.
 - 1) Natural rubber gaskets are not acceptable.
 - e. Lubricants shall be compatible with pipe and gasket materials, shall not support bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints.
 - 1) NSF approved.
- 3. Polyethylene pipe joining:
 - a. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed by the manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and fusion pressures. Prior approval of equipment and personnel shall be obtained before fusion begins. The completed pipe joints shall be guaranteed for five years in writing to the Owner and its Contractor.
 - b. End connections: Special restrained joint mechanical joint adapters may be required for each end of the P.E. pipeline. The price quoted shall include any special end configuration and polyethylene ring to hold a standard mechanical joint.

D. Fittings and specials:

- 1. Ductile iron pipe:

- a. Use 250 psi pressure rated ductile iron fittings or specials unless otherwise indicated, complying with ANSI/AWWA C110/A21.10.
- b. Compact fittings for piping 3" - 16" may be provided in accordance with ANSI/AWWA C153/A21.53.88.b.
- c. Fittings for use with push-on joint pipe, comply with ANSI/AWWA C111/A21.11.
- d. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.
- e. The maximum phosphorous level in the casting will be 0.08%.
- f. The fitting surface finish will conform to MSS SP-112 Quality Standard for Evaluation of Cast Surface Finishes.
- g. The manufacturer shall be ISO 9000 certified.

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- h. Markings
 - * Each fitting shall have the following markings cast integrally to the fitting:
 - 1. Manufacturer's Name or Logo
 - 2. "MJ"
 - 3. Country of origin
 - 4. Manufacturer's Foundry Mark
 - 5. AWWA C-153 or C110
 - 6. Pressure Rating
 - 7. Nominal Diameter (each leg)
 - 8. "DI" or "Ductile"
 - 9. No. of Degrees (bends)

2. Plastic pipe 4" and larger:

- a. Use 150 psi pressure rated ductile iron fittings or specials unless otherwise indicated, complying with ANSI/AWWA C110/A21.10.
- b. Compact fittings for piping 3" - 16" may be provided in accordance with ANSI/AWWA C153/A21.53.88.b.
- c. Fittings for use with push-on joint pipe, comply with ANSI/AWWA C111/A21.11.
- d. Provide adapter glands, gaskets, etc. as required to accommodate any differences in pipe and fitting dimensions.
- e. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.
- f. The maximum phosphorous level in the casting will be 0.08%.
- g. The fitting surface finish will conform to MSS SP-112 Quality Standard for Evaluation of Cast Surface Finishes.
- h. The manufacturer shall be ISO 9000 certified.
- i. Markings
 - * Each fitting shall have the following markings cast integrally to the fitting:
 - 1. Manufacturer's Name or Logo
 - 2. "MJ"

3. Country of origin
 4. Manufacturer's Foundry Mark
 5. AWWA C-153 or C110
 6. Pressure Rating
 7. Nominal Diameter (each leg)
 8. "DI" or "Ductile"
 9. No. of Degrees (bends)
3. Plastic pipe 3" and smaller: Use PVC fittings, 160 psi at 73°F pressure rating, joint design to conform to pipe joints.

E. Couplings:

1. Provide couplings where needed to make piping connections and where located on the plans.
2. Provide mechanical joint ductile iron sleeve, full length, minimum 12".
3. Provide cutting-in sleeve where installing fittings in an existing line.
 - a. Provide ductile iron with mechanical joint.
4. Provide restrained joint couplings where restrained joints are indicated on the plans.

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F. Restrained joint pipe and fittings:

1. Provide restrained joint pipe and fittings on all piping at each fitting, including valve and fire hydrant connections, and on the pipe joints to a distance of 18' each side of the fitting for 12" piping and smaller and to a distance of 36' each side of the fitting for piping over 12".
 - a. Restrained joint pipe (DIP):
 - 1) Fast Grip Gasket by American Cast Iron Pipe Company.
 - 2) Field Lok by U.S. Pipe.
 - b. Restrained Joint Fittings (mechanical Joint DIP):
 - 1) Provide retainer glands for use with mechanical joint pipe and fittings.
 - 2) Provide wedge type.
 - 3) Provide ductile iron gland conforming to ASTM A 536-80. Provide split gland where standard gland cannot be installed.
 - 4) Provide ductile iron set screws, heat-treated to a minimum hardness of 370 BHN with twist-off nuts and permanent standard hex head remaining.
 - 5) Provide for the following rated pressure with minimum 2 to 1 safety factor; 3" - 16" 350 psi, 18" - 48" 250 psi.
 - 6) Provide tee-head bolts conforming to ANSI/AWWA C111/A21.11 latest revision.
 - 7) Provide "MEGALUG" series 1100 or series 1200 as manufactured by EBAA Iron, Inc. of Eastland, Texas, or approved equal.

- c. Provide restraint for C900 PVC by mechanical means separate from the mechanical joint gasket sealing gland.

- 1) Provide wide, supportive contact around full pipe circumference as follows:

<u>Size</u>	<u>Restraint Width</u>
41\ 511	1-1/2"
8 ₁₁ , 10 ₁₁ , 12"	1-3/4"

- 2) Provide means of restraint by machined serrations on inside surface of restraint device designed to provide circumferential loading over the entire restrainer.
- a) Design to be such that restraint increases with increased in-line pressure.
- b) Provide a minimum of 8 serrations per inch of restraint width.
- 3) Restraint device to be pressure rated at 350 psi, or equal to the pipe on which it is used and capable of withstanding test pressures of 2 times pressured rating.
- 4) Fusion applied epoxy coating finish per AWWA C-213.
- 5) Provide series 1600 as manufactured by EBAA Iron, Inc. of Eastland, Texas, or approved equal.

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- d. Provide restraint between PVC and mechanical joint ductile iron fitting where indicated on the plans.

- 1) Provide device consisting of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C111/A21.11.
- 2) The device will have a working pressure rating equal to the pipe on which it is used and include a minimum design pressure safety factor of 2:1.
- 3) Gland body, wedges and wedge actuating components will be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
- 4) An identification number consisting of year, day, plant and shift will be cast into each gland body.
- 5) Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
- 6) Provide series 2000 PV by EBBA Iron, Inc. or equal.

- G. Tee head bolts: Provide Cor-Ten steel tee head bolts for use on mechanical joints complying with ASTM A242.

H. Plugs or caps:

1. Provide at all pipe ends and unused branches of fittings.
2. All plugs and caps shall be tapped 2" and provided with 2" plug.
3. Plugs and caps to be restrained joint.

I. Polyethylene encasement:

1. Provide polyethylene encasement of pipe and fittings where indicated on the plans.
2. Minimum nominal thickness of 8 mils. $\pm 10\%$.
3. Conform to AWWA C105.

2.3 COPPER TRACER WIRE

- A. Provide a continuous 10 gauge blue insulated copper tracer wire when PVC or polyethylene pipe is used.
- B. Approved for direct burial by the manufacturer. **THHN wire shall NOT be used.**
- C. Locate tracer wire a minimum of 6" above top of water main.
- D. Terminate tracer wire inside each valve box and inside meter box and make provisions to allow for connection of testing apparatus without interfering with the proper operation of valves and meters.
- E. Connect to the water line with duct tape at every bell connection or every 20' to ensure that the wire is directly over the top of the pipe.
- F. Place in the trench with all service lines.
- G. Splice at each service lateral and tee connection with an approved copper compression lug.

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2.4 VALVES

A. General:

1. 1-1/2" and smaller: Use gate valves or ball valves.
2. 2" through 12": Use gate valves.
3. Open by turning counterclockwise.
4. End connections as required for the piping in which they are installed.
5. Two-inch metal operating nut with arrow indicating direction of opening.
6. Use valves designed for a working pressure of not less than 250 psi.

7. Provide stem extensions on all valves where the top of the operator nut is located greater than 36" below the top of the valve box.
8. Fully coat all internal ferrous metal surfaces with two part thermosetting epoxy.
9. Design for external stem failure when excessive closing torque is applied with no failure of the pressure retaining parts.
10. Provide two-part thermosetting epoxy coating on valve exterior.
11. Provide stainless steel bolting.
12. Valves to be manufactured in the United States.
13. Provide all wetted rubber compounds of synthetic rubber.

B. Gate valves 1-1/2" and smaller:

1. Use all bronze ball valves, 1/4 turn with stop, 2" square nut operator.
2. Provide Ford Model B11-QT67 or equal.

C. Gate valves 2" through 12":

1. Use resilient seated wedge valves complying with ANSI/AWWA C509.
2. Provide integrally cast bronze stem nut on resilient seated wedge valves.
3. Suitable for working pressure of not less than 250 psi.
4. Design for external stem failure outside of the valve body or bonnet when excessive closing torque is applied with no failure of the pressure retaining parts per AWWA Section 3.2.
 - a. Factory test with no leakage from either side of the disc.
 - b. Test shell to 500 psig.
5. Provide certified to NSF 61.
6. Resilient wedge valves:
 - a. Completely encapsulate resilient iron wedge by an elastomer, without thin spots or voids.
 - b. Provide polymer wedge guide bearing caps bearing surface between the encapsulated wedge and the interior epoxy coating, lowering operation torque and extending service life of the valve.
 - c. The manufacturing plant to have ISO9001 certification.
7. Acceptable manufacturer: Mueller.

D. Valve operator:

1. Provide one T-handle operator for each ten buried valves with nut operator.
2. Provide one stainless steel T-handle operator for each four buried valves with "T" head.

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2.5 HYDRANTS

A. Fire hydrants:

1. Compression type, opening against pressure and closing with pressure, comply with ANSI/AWWA C502 dry-barrel fire hydrants, existing national standards and ANSI B26. Fire hydrants shall meet all test requirements and be listed by the Underwriters Laboratories. Fire hydrants shall meet all test requirements and have full approval of Factory Mutual.
2. Waterway valve opening, 5-1/4" with EPDM main valve. Minimum 250 psi working pressure. Factory tested to a minimum of 250 psi.
3. Six inch (6") bell connection, two (2) 2 W' hose connections, one (1) 4 W' pumper nozzle (STORZ Connection), set screw, lock ring, etc., and shall conform to existing national standard specifications and ANSI B26.
4. National standard screw threads on outlet nozzles.
5. Open by turning counter-clockwise, with arrow cast on the bonnet flange indicating direction of opening.
6. Two part breakable safety flange shall be an integral part of barrel casting at least 2" above bury line.
7. Barrel lengths shall generally be for 3'6" bury.
8. Interior shall be two (2) part thermosetting, or fusion bonded, and coated holiday free to a minimum thickness of 4 mil conforming to AWWA C550 protective interior coatings for valves and hydrants.
9. Exterior coating shall be YELLOW industrial enamel, color to match Owner's standard.
 - a. Exterior hydrant parts below ground will be asphaltic or epoxy coated.
10. An all bronze seat ring shall thread directly into an all bronze drain ring or heavy bronze bushing located between the lower hydrant barrel and shoe securely retained in this position, or it may be threaded into a heavy bronze bushing in the hydrant shoe. Drain rings cast into iron body are not acceptable.
11. All bronze or brass internal working parts in contact with service water are to be maximum 16% zinc content and 79% minimum copper.
12. Retaining bolts of shoe to lower barrel shall be 316 stainless steel.
13. Acceptable products: Mueller Company (Super Centurion 250 A-423).

B. Reflector:

1. Provide industry standard blue hydrant reflector for paved roadway.

C. Offset fitting:

1. Provide an offset fitting at sloped areas where required for the hydrant connections to be located 1'4" above finished grade.
2. Locate between the shut-off valve and each hydrant with a 12" offset.
3. Provide ductile iron per AWWA C153, compact design, coated per AWWA C104.
4. Provide Grade Lok as manufactured by Assured Flow Sales, Inc., or approved equal.

2.6 FLUSH TYPE HYDRANTS

- A. Provide Mueller Company Catalog No. A-411 or approved equal.
- B. Waterway valve opening, 2-1/8".

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- C. One 2-1/2" hose connection.

- D. National Standard screw threads on outlet nozzle.
- E. Open by turning counterclockwise, with arrow cast in top indicating direction of opening.
- F. Depth of bury, 3'0" minimum.
- G. Finish coat with red enamel.
- H. Provide cap chain.

2.7 VALVE BOXES

- A. Provide at each buried valve.
- B. Cast iron extension type, suitable for minimum cover of 3'6" over the pipe.
- C. Minimum inside diameter at the top of 5", minimum wall thickness 3/16".
- D. Have the word "WATER"; "SEWER"; "SLUDGE", etc., as applicable, cast into the cover.
- E. Provide Tyler Series 6850.
- F. Where depth requires more than a two piece box use adjustable cast iron extensions.
- G. Coat box and cover with two (2) shop coats of bitumastic paint.

2.8 VALVE BOX PROTECTION RING

- A. Provide at each valve box a precast concrete protection ring.
- B. Provide two rings of No. 3 reinforcing steel, one 14" in diameter, and one 23" in diameter.
- C. Inside dimensions to be 9-1/4".
- D. Outside diameter to be 27".
- E. Provide 5" thickness at interior with a continuous slope to 2" thickness at the outside.
- F. Minimum weight of 110 lbs.

2.9 SERVICE SADDLE

- A. See Section 02661 - Water Service Connections.

2.10 SERVICE **LINE** TUBING

- A. See Section 02661 - Water Service Connections.

2.11 TAPPING SLEEVE AND VALVE

A. Tapping sleeve:

1. Provide Type 304L stainless steel per ASTM A240.
2. Provide rolled thread stainless steel bolts per ASTM A 153, Type 304.
3. Provide Type 304 stainless steel hex head nuts, coated to prevent galling.
4. Virgin SBR gaskets, compounded for water and wastewater service.
5. Provide 3/4" NPT stainless steel test plug.
6. Maximum working pressure of 200 psi.
7. Provide ROMAG Industries Model SST or approved equal.

B. Tapping valve:

1. Construct of material compatible with tapping sleeve.
2. Valve to conform to Paragraph 2.4 above.
3. Joints - Flange to tapping sleeve, Mechanical Joint for pipe end.

2.12 TRANSITION/REPAIR COUPLING

A. Provide Smith-Blair model 411 steel coupling.

2.13 MISCELLANEOUS PARTS AND ACCESSORIES

- A. Use standard commercial grade suitable for the type of installation or system involved, and conforming to the applicable standards and specifications of the AWWA.

PART 3 - EXECUTION

3.1 HANDLING

A. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:

1. Carry pipe into position - do not drag.
2. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe.
3. Use care not to injure pipe linings.
4. Do not damage pipe with chokers or lifting equipment.

B. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during laying operations by plugging or other method approved by the Engineer.

C. Before installation, inspect each piece of pipe and each fitting for defects.

1. Material found to be defective before or after laying: Replace with sound material meeting the specified requirements, and without additional cost to the Owner.
- D. Gaskets: Store in a cool dark place until just prior to time of installation.

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3.2 PIPE CUTTING

- A. Cut pipe neatly and without damage to the pipe.
- B. Unless otherwise recommended by the pipe manufacturer, and authorized by the Engineer, cut pipe with mechanical cutter only.
 1. Use wheel cutters when practicable.
 2. Cut plastic pipe square, remove all burrs, and grind bevel on end.

3.3 LOCATING

- A. Water mains shall be laid at least 10' edge-to-edge horizontally distanced from any existing or proposed sewer pipes.
- B. Should a 10' separation not be practical, then the water main may be located closer with South Carolina Department of Health and Environmental Control (SCDHEC) approval provided:
 1. It is laid in a separate trench.
 2. It is laid in the same trench with the water main located at one side on a bench of undisturbed earth.
 3. In either of the above cases, crown elevation of the sewer shall be at least 18" below invert elevation of water line.
- C. Where water lines cross over sewers, maintain 18" vertical separation between the outside of the sewer and the outside of the water line.
- D. Where water lines cross under sewers, each line shall be cast iron or ductile iron.
 1. A full length of water line shall be located over an existing sewer so that joints of each line will be as far from each other as possible.
 2. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other.
- E. No water pipe shall pass through or come in contact with any part of a sewer manhole.
- F. Water lines shall not be laid within 25' horizontally from any portion of a wastewater tile or spray field.

- G. Water lines shall be located outside all contaminated areas, unless using pipe materials that will protect the water supply.
- H. No flushing device or drain directly connected to any type of sewer is allowed.
- I. No cross connections between water lines and any pipes, valves, tanks or pumps that are not part of the potable water system are allowed.
- J. Water lines may come in contact with storm sewers or catch basins if there are no other practical alternatives provided that ductile iron is used and no joints of the water line are

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Within the storm sewer or catch basin, and, provided that the joints are located as far as possible from the storm sewer or catch basin.

- K. Structures containing valves, blowoffs, meters, air release valves, etc., shall not be connected directly to any storm drainage or sewer system.

3.4 EXCAVATION AND BACKFILLING

- A. Comply with pertinent provisions of Section 02221 and Section 02615 of these Specifications.
- B. For P.E. Pipe, comply with manufacturer's recommendations.

3.5 ALIGNMENT OF PIPE

- A. Pipe lines intended to be straight shall be so laid.
- B. Where vertical or horizontal alignment requires deflection from straight line or grade, such deflection shall not exceed maximum deflection recommended by the pipe manufacturer.
- C. If alignment requires deflection exceeding recommended limits, furnish special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the allowable limits.

3.6 PLACING AND LAYING

A. General:

1. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the Engineer.
2. Do not dump or drop any of the materials of this Section into the trench.
3. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.
4. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
5. Take up and relay pipe that has the grade or joint disturbed after laying.
6. Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed.
7. Securely close open ends of pipe, fittings, and valves when work is not in progress.
8. Where any part of coating or lining is damaged, repair to the approval of the Engineer and at no additional cost to the Owner.
9. Structures containing valves, blowoffs, meters, air release valves, etc., shall not be connected to any storm drain or sewer system.

B. Ductile iron pipe:

1. Mechanical, push on and flanged joints, install in accordance with ANSI/AWWA C600.
2. Gaskets: Handle, lubricate where necessary and install in strict accordance with manufacturer's recommendations.

C. Plastic pipe:

1. Clean gasket, bell or coupling interior, especially *groove* area.
2. Lubricate and insert gasket as recommended by manufacturer.
3. Align spigot to bell, insert spigot into bell until it contacts gasket uniformly.
4. Bell pipe using manufacturer's approved leverage bar.
 - a. Do not use machinery to push pipe "home".
5. Push pipe "home" until reference mark is at proper location and clearly visible.
6. Follow all pipe manufacturers installation instructions.

D. Flanged joints:

1. Provide true face flanges, field clean and fit with one full face gasket and make bolts up finger tight.
2. Use torque wrench to alternately tighten bolts 180° apart until full gasket flow and seal are secured.
3. Bias cut or unusual refacing of any flange will not be acceptable.

E. Restrained joints:

1. Install in accordance with manufacturer's instructions.
2. Tighten set screws to the manufacturer's rated torque using a torque wrench. If twist-off nuts are provided, tighten screws until nut breaks loose.

F. HOPE pipe:

1. Install in accordance with manufacturer's recommendation and ASTM D 2321.
2. Provide factory-trained personnel to conduct effusion joint work.

G. Polyethylene encasement: Comply with AWWA C105.

3.7 SETTING VALVES AND VALVE BOXES

A. General:

1. Center *valve* boxes on the *valves*, setting plumb.
2. Tamp earth fill around each *valve* box to a distance of 4' on all sides, or to the undisturbed trench face if less than 4'.
3. Install shaft extensions plumb without any binding.
4. Fully open and close each *valve* to assure that all parts are in working condition.
5. Place *valve* box protection ring around top of *valve* box as indicated on the plans.
 - a. Install ring level with top 1" *above* finished grade.
 - b. Top of ring to be level with or no more than 1" *above* the top of the *valve* box.

3.8 INSTALLATION OF HYDRANTS

A. General:

1. Inspect carefully, ensuring that all foreign material is *removed* from the barrel.
2. Set plumb and at such elevation that connecting pipe and distribution main have same depth of *cover*.
3. Install stone drainage bed and thrust blocking as indicated.
4. No connection or location of hydrant drains within 10' of sewer systems is allowed.

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5. Hydrant leads to be a minimum of 6" in diameter and to include an auxiliary gate valve.
6. Fully open and close each hydrant to assure that all parts are in working condition.
7. Install blue hydrant reflector on centerline of paved roadway marking the perpendicular location of hydrant with reference to the road centerline.

3.9 THRUST BLOCKS

A. General:

1. Provide thrust blocks, or metal tie rods and clamps or lugs, on plugs, caps, tees, hydrants and bends deflecting 11-1/4° or more either vertically or horizontally, and on all except restrained joint water lines. Thrust blocking is not required where restrained joints are indicated.
2. Provide concrete thrust blocking with a compressive strength of 3000 psi in 28 days.
3. Size of the blocking will be determined by the Engineer, based on soil bearing capacity.
4. Provide 8 mil. polyethylene film between the thrust block and fittings.

B. Installation:

1. Locate thrust blocking between solid ground and the fitting to be anchored.
2. Unless otherwise shown or directed by the Engineer, place the base and thrust bearing sides of thrust blocking directly against undisturbed earth.
3. Sides of thrust blocking not subject to thrust may be placed against forms.
4. Place thrust blocking so the fitting joints will be accessible for repair.
5. Protect steel rods and clamps by hot dipped galvanizing.

3.10 HYDROSTATIC TESTING

A. General:

1. Pressure and leakage testing must be conducted in accordance with AWWA Standards C600.
2. Clean and flush line of air, dirt and foreign material.
3. Do not perform hydrostatic tests until at least five days after installation of concrete thrust blocking.
4. Test pump, pipe connection, pressure gauges, measuring devices and all other necessary appurtenances to conduct tests are to be provided by the Contractor.

5. Install brass corporation cocks at all high points that do not have permanent air vents. Corporation cocks are to be left in place and all costs for providing such cocks are to be borne by the Contractor.
6. Conduct tests on each line or valved section of line.
7. Test pressures to be 150 psi, or 1.5 times the maximum working pressure, whichever is greater, based on the elevation of the lowest point of the section under test and corrected to the elevation of the test gauge.
8. Do not test pipe at pressures exceeding manufacturer's recommendations.
9. The Contractor must provide documentation of the pressure and leakage tests. Documentation must include length of lines, diameter of pipe(s), amount of water required to fill line after test was performed, and amount of allowable leakage.
10. The witness to the hydrostatic testing is to be someone other than the Contractor or the utility installing the lines.

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B. Pressure tests:

1. After the pipe is laid, the joints completed, and the trench backfilled, subject the newly laid piping and valved sections of the piping to the test pressure specified in Part A above.
2. Open and close each valve within the section being tested several times during the test period.
3. Replace or remake joints showing leakage.
 - a. Remove cracked pipe, defective pipe, and cracked or defective joints, fittings and valves. Replace with sound material and repeat the test until results are satisfactory.
 - b. Make repair and replacement without additional cost to the Owner.

C. Leakage test:

1. Conduct leakage test after the pressure test has been completed satisfactorily.
2. Duration of each leakage test: At least two hours.
3. During the test, subject water lines to the test pressure specified in Part A above.
4. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
 - a. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula(s):

- 1) Ductile iron piping:

$$L = S \times D \times .Jr / 133,200; \text{ where}$$

L = allowable leakage in gallons per hour;

S = length of pipe tested in feet;

D = nominal diameter of pipe in inches; and P
= average test pressure psi gauge.

2) PVC piping:

$$L = N \times D \times .Jp / 7400; \text{ where}$$

L = allowable leakage in gallons per hour;
N = number of joints in pipeline being tested;
D = nominal diameter of pipe in inches; and P
= average test pressure psi gauge.

b. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size will be allowed.

- 1) Should any test of pipe disclose leakage greater than that specified above, locate and repair the defective joint or joints until the leakage is within the specified allowance, and at no additional cost to the Owner.
- 2) Repair all visible leaks regardless of test results.

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3.11 STERILIZATION

A. General:

1. Upon completion of testing, sterilize all water lines to meet requirements of the South Carolina Department of Health and Environmental Control.
2. Newly laid valves or other appurtenances shall be operated several times while line is filled with chlorinating agent.
3. Should initial treatment fail to meet results specified, repeat procedures until satisfactory results are obtained, at no additional cost to the Owner.
4. All pipe taps, feeders, chemicals, etc., for sterilization shall be provided by the Contractor.

B. Procedure:

1. Flush line to extent possible with available pressure and outlets, prior to sterilization.
 - a. Hydrant openings required to produce proper flushing velocity at 40 psi are:

Pipe Size (Inches)	Hydrant Openings
4 through 12	one 2-1/2"
14 through 18	two 2-1/2"
20	one 4-1/2"

2. Comply with the latest revision of AWWA C651 and the following:
 - a. Apply chlorine as liquid chlorine or chlorine compound such as calcium hypochlorite with known chlorine content.
 - b. Apply through corporation cock in top of main located no greater than ten (10) sections from the beginning of section being sterilized.
 - c. Control water flow to a slow flow into the line.
 - d. Use proper feeder and flow regulator to introduce chlorinating agent.
 - e. Application rate shall be not less than 25 ppm and no greater than 50 ppm.
 - f. Retain chlorinated water in main not less than 24 hours.
 - g. At end of retention period, at least 10 ppm of chlorine shall remain in the water at the extreme end of section.
 - h. Dechlorinate and flush line thoroughly.

C. Acceptance:

1. Provide two separate samples for each sample location, taken at 24-hour intervals, free of coliform bacteria.
 - a. 1st and 2nd samples shall be taken by a SC DHEC approved technician and delivered to a South Carolina Department of Health and Environmental Control (SCDHEC) approved laboratory for testing.
 - b. The first and second sample results shall include the free chlorine residual at the time the samples were collected.
 - c. Notify SCDHEC to take a 3rd sample.
2. At a minimum, sample locations shall be as required by SCDHEC and the following:
 - a. The tie-in location of new and existing water lines.
 - b. The end of all dead end lines.

- c. At intervals of no more than 1,200' for all new lines longer than 1,200' in length.

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- 3. All sample locations are to be given an identifying label and a corresponding identification label is to be included on the record drawings indicating each sample location.

3.12 DECHLORINATION OF CHLORINATED STERILIZATION WATER

- A. Dechlorinate the chlorinated water used for sterilizing water lines.
- B. Apply dechlorinating agent as liquid sulfur dioxide or sulfite salts.
- C. Prepare a mixing chamber using a 55-gallon tank. Feed the discharge and dechlorinating agent at the bottom of the tank with overflow at the top.
- D. Discharge total chlorine residual to be less than 0.5 milligrams per liter.

END OF SECTION

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SECTION 02661

WATER SERVICE CONNECTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide water service connections, including meters, meter boxes, and other appurtenances as shown on the drawings, specified herein, and needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Section 02221 - Trenching, Backfilling for Utilities.
 - 3. Section 02660 - Water Distribution

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. All materials in this Section are to be manufactured in the United States.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01640.

PART 2 - PRODUCTS

2.1 SERVICE PIPE

WATER SERVICE CONNECTIONS

- A. Use materials for the various sizes of services as follows:
- B. Services 1" in diameter and smaller:

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1. For 3/4" and 1" services, provide BLUE CTS (OD Controlled) size polyethylene tubing, with SODR=9 (250 psi pressure rating) that complies with ASTM D2737-12.
 - a. Provide tubing manufactured from PE 4710 BI-Modal HDPE resin.
 - b. Acceptable products: Endopure, as manufactured by Endo! Industries, Rockaway, NJ.

2.2 SERVICE SADDLE

- A. Provide Smith-Blair Model 317 Double Stainless Steel Strap Service Saddle. Double strap Ductile Iron service saddle with TaperSeal™ gasket and wraparound 304 Stainless Steel strap for added corrosion resistance.
- B. Body shall be ductile iron per ASTM A536. Finish for body shall be Flexi-Coat® Fusion-Bonded Epoxy Finish per AWWA C213.
- C. 304 stainless steel, straps, bolts, nuts, washers, and studs.
- D. GASKET: Nitrile (Buna N) NSF 61® compounded to resist oil, acids, alkalies, most (aliphatic) hydrocarbon fluids, water and other chemicals.
- E. 150 PSI minimum working pressure.
- F. Meets AWWA C800.
- G. Connect to pipeline using a 6" stainless steel nipple.
 1. Do not use a threaded PVC connection.

2.3 BRASS MATERIALS

- A. Provide materials complying with AWWA Standard C800, unless otherwise indicated or specified.
- B. Corporation stops: Provide Mueller model H-15006N. AWWA taper thread inlet and INSTA- TITE connection for CTS PE tubing outlet.
- C. Service fittings: Provide Mueller model H-15074N with INSTA-TITE connection for CTS O.D. PE tubing x female copper flare thread.
- D. Brass Nipples shall conform to ASTM B687-88. Nipples shall be threaded with American Standard taper pipe threads (NPT) in accordance with screw-thread standard for Federal Services Handbook H-28. Nipples shall have NSF/ANSI 61 certification.

2.4 YOKEBOXES

- A. Provide Ford Meter Yokebox Model LYL121-233-P-LN-NL 5/8" x 3/4" with 3/4 straight flare copper inlet key valve (less nut), 3/4 FIP outlet, cast iron upper, and plastic locking lid.

- B. Provide Ford Meter Yokebox Model FPMBH7T95015029 2" Cast iron upper and Plastic locking lid.
- C. No lead allowed.

2.5 METERS

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- A. Provided by the Owner.

2.6 TURF BOXES

- A. Provide NOS 6" Round Valve Boxes for shut-off valves and pressure reducing valves.

2.7 SHUT-OFF VALVES

- A. Provide Hammond Model 606 3/4" Gate Valve.

2.8 PRESSURE REDUCING VALVES

- A. Provide Watts Series LF25AUB-Z3.

2.9 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install service lines from the distribution main to the property lines at each lot, or at each location indicated or directed by the Engineer.
- B. Depth of the service connection shall be no less than the top of main connected to, and shall be at least 12" deep at the meter box.
- C. Install insulating couplings between ferrous and non-ferrous pipe, fittings, etc. of such shape to effectively prevent metal-to-metal contact between the dissimilar metals.

3.2 EXCAVATION AND BACKFILLING

- A. Comply with pertinent provisions of Section 02221, except as otherwise specified herein.
- B. Under paved areas install service lines byjetting, unless otherwise directed by the Engineer.

3.3 INSTALLATION - SERVICE LINES

- A. Install flexible service lines in one continuous piece from main to service stop.
- B. Connections to PVC and DIP mains:
 - 1. Use approved service saddle on existing and new mains.
 - 2. Provide corporation stop at all connections.
- C. Terminate each service line with meter assembly, as shown in the detail on the plans.

- D. The connection to the existing property owner's service line past the point of service (i.e. the meter box at the edge of the right-of-way) shall be performed by a licensed plumber. The licensed plumber shall obtain a permit from the City of Newberry for every property.

- E. The Contractor (with WL license) may install the service line and meter up to the point of service (i.e. the meter box at the edge of the right-of-way).
- F. All work performed shall be in accordance with the latest revision of the International Plumbing Code.

3.4 INSTALLATION - METER BOXES AND METERS

- A. Install boxes level in both directions and with top flush with finished grades.
- B. Do not let weight of box rest on the service line.
- C. Make installation in such manner that meter may be removed at any time without disturbing box setting.
- D. The meter box assembly shall be installed on an 8" CMU block (the CMU's cell openings shall be facing upward).

3.5 FLUSHING

- A. Flush each service line thoroughly after installation to clear of sand, dirt, or other construction debris.
- B. When meters are to be installed, accomplish flushing prior to meter installation.

END OF SECTION

SECTION 02722

SEWERS: SANITARY, GRAVITY

PART 1• GENERAL

1.1 DESCRIPTION

- A. Work included: Provide sanitary sewerage system as shown on the drawings, specified herein, and needed for a complete and proper installation.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
 - 2. Section 02221 - Trenching, Backfilling for Utilities

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 5 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1A PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01640.
- B. Storage of PVC pipe:
 - 1. Store in unit packages as received from manufacturer until just prior to use.
 - 2. Stack units in such a manner as to prevent deformation to pipe barrel and bells.
 - 3. Protect from direct sunlight by covering with opaque material if storage period will exceed six weeks.

SEWERS: SANITARY, GRAVITY

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- C. Avoid severe impact blows, gouging or cutting by metal surfaces or rocks.
- 1.5 ORDER AND ACCEPTANCE OF WORK
- A. Unless otherwise noted, work shall commence with outfalls, to mains, thence to laterals.
 - B. Owner reserves right to accept and use any portion of Work whenever it is considered to be in the public interests to do so.
- 1.6 PROTECTION OF OTHER UTILITIES
- A. Location:
 - 1. Approximate location of certain known underground lines is shown.
 - 2. Existing small lines not shown.
 - 3. Locate small and other possible utility lines using electronic pipe finder, or other approved method.
 - 4. Excavate and expose existing underground utilities ahead of trenching operations.
 - B. Repair or replace any damaged utility line or structure at no additional cost to Owner.
- 1.7 CONFLICTING UTILITIES
- A. Remove and/or relay conflicting utilities, when so directed by the Engineer, at the expense of the Owner.
 - B. Where alterations to existing utilities are shown to avoid conflicts, make alterations at no cost to Owner.
- 1.8 JOB CONDITIONS
- A. Work under this Section may require construction or work in a confined space, defined as any space having one or more of the following characteristics:
 - 1. Limited openings for entry and exit.
 - 2. Unfavorable natural ventilation.
 - 3. Not designed for continuous worker occupancy.
 - B. The Contractor shall have on the job site at all times the following minimum safety equipment:
 - 1. Gas monitor capable of testing and detecting for combustible gas, oxygen deficiency and hydrogen sulfide.
 - 2. Confined space access and retrieval winch system.
 - 3. Ventilating fan with large diameter ventilating hose.
 - 4. Supplied air respirator, MISHA/NIOSH approved type.
 - 5. Safety harness and lifelines.

Equipment listed above is to be available for use by the Contractor, Engineer and Owner for the duration of the project.

- C. All entries into or work within confined spaces to be conducted in accordance with the U.S. Department of Health and Human Services/National Institute for Occupational Safety and Health [DHHS (NIOSH)] Publication No. 87-113, A Guide to Safety in Confined Spaces.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe shall be subject to Engineer's observation, at plant, trench or other point of delivery, for culling and rejecting pipe, independent of laboratory tests, not conforming to specifications.
- B. Rejected pipe will be marked by the Engineer and Contractor shall remove it from project site.

2.2 PIPE AND FITTINGS

- A. Use any pipe material specified herein, except where use of a particular pipe material is indicated on the Contract Drawings.
- B. Ductile-iron pipe and fittings (DIP):
 - 1. Comply with ANSI/AWWA C150/21.50 and ANSI/AWWA C151/21.51, latest revision.
 - 2. Use mechanical or push-on joints complying with ANSI/AWWA C111/A21.11 as modified by ANSI/AWWA C151/A21.51.
 - 3. Use rubber gaskets and lubricant complying with ANSI/AWWA C111/A21.10.
 - 4. Use wall thickness in accordance with table included herein for depth and bedding conditions.
 - 5. Use fittings with pressure rating of 150 psi, complying with ANSI/AWWA C110/A21.10.
 - 6. Use lining complying with one of the following:
 - a. Polyethylene lining complying with ANSI/ASTM D 1248, 40 mils nominal thickness or;
 - b. Amine cured Novalac Epoxy polymeric lining, 40 mils nominal thickness. The standards of quality are based on Protecto 401 by Vulcan Painters, Birmingham, Alabama or Corrosion-Clad Polymer Lining No. 210 by Seauereisen Cements, Pittsburgh, Pennsylvania.
- C. Polyvinyl chloride pipe and fittings (PVC):
 - 1. Use integral wall bell and spigot, minimum of SDR35, complying with ASTM 3034.

2. Use elastomeric gasket joints, providing watertight seal.
 3. Furnish pipe in 12.5 or 20-foot lengths.
 4. Sweeping service tees (gasket joints) shall be used for all service connections to the main sewer line.
 5. Service laterals shall be Schedule 40 (ASTM 01785) with solvent weld coupling joints. See paragraph 2.6 for specifications.
- D. Service Couplings (for transitions from cast iron and clay service lines to PVC)
1. Mission Couplings ARC adjustable repair coupling with stainless steel shear ring shall be used to transition from the existing service lines to the new PVC service lines.
 2. Provide the appropriate Mission ARC coupling depending on the type of the existing service line material.
 3. 12 inches of #5 stone shall be installed under the transition coupling.

2.3 MANHOLES

- A. Use precast manholes (manufactured by Tindall Corporation of Spartanburg, SC or approved equal):
1. Provide reinforced precast concrete ring and eccentric cone sections complying with ASTM C 478 and the following.
 2. Use Portland cement complying with ASTM C 150, Type II.
 3. Cast base slab monolithically with walls.
 4. Design flat slab top sections for HS-20 traffic loadings.
 5. Cast ladder rungs into the units.
 - a. Embed a minimum of 3".
 - b. Maximum spacing - 16".
 6. Provide tongue and groove with vulcanized butyl rubber sealant or O-ring rubber gasketed joints.
 7. Cast or factory cut pipe opening in manholes:
 - a. Provide flexible pipe boot conforming to ASTM C923M.
 - b. Attach boot to piping with dual stainless steel straps.
 - c. All other hardware to be stainless steel.
 - d. Provide Kor-N-Seal or equal.
 8. Size lift holes and inserts for a precision fit with the lift devices.
 - a. Holes shall not penetrate through the manhole wall.
 - b. Comply with OSHA Standard 1926.704.

9. Provide flat slab tops where manhole depth is less than 4'0".
 10. Provide manhole linear where shown on the drawings or noted in the specifications.
- B. Steps:
1. Provide polypropylene plastic steps reinforced with 3/8" diameter steel rod, M.S.A. Industries, Inc. Model PS-K, or equal.
 2. Provide steps having non-skid top surfaces, safety slope at each end, minimum width of 10" and not less than 5" projection from wall.
- C. Exterior joint collar:
1. Install an exterior joint collar on all manhole joints.
 2. Provide a 12" wide band.
 - a. Provide an outer layer of polyethylene with an under layer of rubberized mastic reinforced with a woven polypropylene fabric.
 - b. Provide a peelable protective paper against the mastic that is removed when the collar is applied to the joint.
 - c. Design the collar so that when it is applied around the joint the ends overlap at least 6".
 3. Provide SealWrap Exterior Joint Sealer as manufactured by Mar-Mac Manufacturing Company or equal.
- D. Frames and covers:
1. Provide gray iron castings, complying with ASTM A 48, Class 30 iron.
 2. Machine all bearing surfaces.
 3. Provide frames weighing not less than 195 lbs. with inside opening between 21" and 24".
 4. Provide circular cover with two "pick" holes and weighing not less than 120 lbs.
 5. Covers to have the words "SANITARY SEWER" cast in the metal.
 6. Provide watertight covers, where indicated, conforming to above requirements and with frame tapped for four bolts, countersunk in cover.
 - a. Provide rubber gasket between frame and cover.
 7. Manhole frame and cover to be **US Foundry (USF) model KL-668**.
- E. Precast grade rings:
1. Use Precast Grade Rings to adjust ring and covers to finished grade.
 2. No more than 8 vertical inches of grade rings will be allowed per manhole.
 3. Conform to ASTM C 478
 4. Provide no less than 4" in height.
 5. Use cement brick for adjustments less than 4".

F. Precast inverts:

1. Provide precast inverts.
 - a. Pipe openings shall provide clearance for pipe projecting a minimum of 2" inside the manhole.
 - b. The height of the transition from the pipe opening to the invert trough shall be equal to one-half of the Opening ID minus Pipe ID, $\pm 1/4$ ".
2. The crown of small LO. pipe shall be no lower than the crown of the outlet pipe.
 - a. When the fall between the inlet and the outlet holes is greater than 4", the inlet end of the trough shall be below the inlet pipe invert and aligned horizontally within 1".
 - b. Form and finish troughs to provide a consistent slope from the pipe outlet to the inlets up to 4" fall.
 - i. Minimum fall of 1" or as noted on drawings.
 - ii. Minimum bending radius of the trough centerline-1.5 times the pipe 1.0.
 - iii. Provide a 1/2" radius at the intersection of 2 or more channels.
 - iv. The minimum concrete thickness from the bottom of the trough to the bottom of the base shall be 7".
 - c. Float finish benches to provide a uniform 2-1/2" slope, ± 1 ", from the high point at the manhole wall to the low point at invert trough.
 - i. Provide a 1/4" radius at the edge of the bench and trough.
 - d. Fill, depressions, high spots, voids, chips, or fractures over 14" in diameter or depth with a sand cement paste and finish to a texture reasonably consistent with the formed surface.

2.4 CLEANOUTS

- A. Provide cleanouts where noted on the Contract Drawings or as directed by the Engineer or Owner.
1. Locate within the Owner's right-of-way.
 2. Provide cleanout as shown on the standard detail of the Contract Drawings.
 3. Provide 4" diameter cleanouts for all pipe sizes.
 4. Comply with the latest adopted version of the International Plumbing Code or local codes where applicable.
 5. All cleanouts shall have a concrete donut located at the top.

2.5 Backwater Valve (Sewer Service Line)

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- A. Provide backwater where noted on the Contract Drawings or as directed by the Engineer or Owner.
 - 1. Locate within 5 feet of the residence.
 - 2. Provide Adapt-a-Valve Extendible Backwater Valve manufactured by Mainline Backflow Products or an Engineer approved equal.
 - 3. Provide 6" diameter extension pipe with standard cleanout screw top.
 - 4. Comply with the latest adopted version of the International Plumbing Code or local codes where applicable.
 - 5. All backwater valve extension cleanouts shall have a concrete donut (for a 6" cleanout) located at the top.
 - 6. Provide 3/4" PVC pipe extension for the cassette for all valves installed deeper than 2 feet.

2.6 SERVICE PIPE AND FITTINGS

- A. Provide Schedule 40 PVC pipe and fittings in conformance with the requirements of ASTM D-1785.
- B. Fittings shall conform to ASTM 2466.
- C. Provide PVC material with cell classification of 12454 as defined in ASTM D-1784.
- D. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D2672.
- E. Joints shall be solvent cemented complying with ASTM D2564 and the following:
 - 1. Primer:
 - a. Provide NSF approved low VOE and PVC primer that meets the requirements of ASTM F-656.
 - b. Provide IPS Weld-On P-70 primer or equal.
 - 2. Solvent Cement:
 - a. Provide NSF approved PVC chemical resistant solvent cement that meets the requirements of ASTM D2564 and SCAQMD Rule 1168/316A.
 - b. Provide IPS Weld-On 711 solvent cement or equal.

2.7 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 • EXECUTION

3.1 LAYING OUT WORK

- A. Provide all materials, labor, instruments, etc. required to lay out Work.
- B. Prepare "cut sheets" under direct supervision of the Engineer.
- C. Exercise proper precaution to verify figures on the drawings prior to laying out Work. Contractor will be held responsible for any errors therein that otherwise might have been avoided.
- D. Promptly inform Engineer of errors or discrepancies found, in order that proper corrections may be made.

3.2 LOCATION

- A. Sewer lines in relation to water lines must conform to South Carolina Standards for Wastewater Facility Construction R.61-67 section 67-300 paragraph A.14.
- B. Where the sewer location is not located clearly by dimensions on the drawings, locate the sewer:
 - 1. Not closer than 10' horizontally from a water supply main or service line. The distance shall be measured edge to edge.
 - 2. Where it is not practical to maintain a 10' horizontal separation, the sewer pipe may be installed closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18" above the top of the sewer.
 - 3. Where sewers are crossing a water main, either above or below, provide a minimum vertical distance of 18" between the outside of the water main and the outside of the sewer.
 - 4. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
 - 5. Where a water main crosses under a sewer, fully encase the sewer pipe for a distance of 10' on each side of the crossing; or
 - 6. Use acceptable pressure pipe with no joint closer horizontally than 3' feet from the crossing. This pipe will be pressure tested to assure watertightness prior to backfilling.
 - 7. Where concrete encasement is used, provide not less than 4" thickness including that on pipe joints.

3.3 INSTALLATION

- A. Trench, backfill and compact for the work of this Section in strict accordance with pertinent provisions of Section 02221 of these specifications, and the following requirements:
 - 1. Maximum trench widths, depths and bedding methods.

- a. Install all sewers complying with tables for depths of cut and class of bedding included hereinafter.
 - b. Where trenches are excavated beyond specified widths, or trench walls collapse, lay sewer complying with requirements of the next better class of bedding at no additional cost to the Owner.
 - c. Include cost of special bedding and tamping in unit prices bid for sewer.
2. Ductile-iron pipe:

MAXIMUM DEPTHS IN FEET						
PIPE SIZE	MAX. TRENCH WIDTH	CLASS OF PIPE	CLASS OF BEDDING			
			D FLAT BOTTOM TRENCH	C TYPE 1 OR TYPE 2	B TYPE 1 OR TYPE 2	A SPECIAL CONCRETE BEDDING
8"	2'2"	50	24	28	32	35
10"	2'4"	50	15	24	32	35
10"	2'4"	51	24	32	35	35
12"	2'6"	50	16	20	32	35
12"	2'6"	51	20	24	35	35
12"	2'6"	52	28	32	35	35
14"	2'9"	50	14	16	32	35
14"	2'9"	51	16	20	35	35
14"	2'9"	52	24	28	35	35

3. Polyvinyl chloride pipe (SDR35):

MAXIMUM DEPTHS IN FEET					
PIPE SIZE	MAX. TRENCH WIDTH	CLASS OF BEDDING			
		D FLAT BOTTOM TRENCH	C TYPE 1 OR TYPE 2	B TYPE 2* ONLY	A SPECIAL CONCRETE BEDDING
4"	2'0"	**	**	30	30
8"	2'2"	**	**	30	30
10"	2'4"	**	**	30	30
12"	2'6"	**	*	30	30
15"	2'10"	**	*	30	30

* Class B Bedding shall extend to the top of the pipe.

• Do not use this Class of bedding for this pipe size and trench width.

4. Reinforced concrete pipe: N/A
5. Bedding and tamping requirements for the various classes of bedding shall comply with the following specifications:

- a. Class B {Type 2} Bedding - Undercut 4" below pipe barrel, full width of trench; bring to grade with compacted crushed stone complying with SCOOT Aggregate No. 5.
 - 1) For pipe other than PVC, place stone in six-inch layers to mid- point of pipe, compacting by slicing with shovel.

- 2) For PVC pipe, place stone (Aggregate No. 5) in six-inch layers to the mid-point of the pipe, compacting by slicing with shovel.
- 3) Complete trench backfill complying with Section 02221.

B. Drain stop:

1. Provide a drain stop at 100' intervals where Class B (Type 2) bedding is used.
2. Drain stop to consist of compacted soil 2' in length.
3. Remove water from excavation prior to placing drain stop.

C. Pipe laying:

1. General:

- a. Protect pipe during handling against shocks and free fall. Remove extraneous material from the pipe interior.
- b. Lay pipe by proceeding upgrade with the spigot ends of bell-and-spigot pipe pointing in direction of flow.
- c. Lay each pipe accurately to the indicated line and grade, aligning so the sewer has a uniform invert.
- d. Continually clear interior of the pipe free from foreign material.
- e. Before making pipe joints, clean and dry all surfaces of the pipe to be joined.
- f. Use gasket lubricants as recommended by the pipe manufacturer.
- g. Place, fit, join and adjust the joints to obtain the degree of water tightness required.

2. Polyvinyl chloride pipe:

- a. Select proper bedding class from preceding table as determined by pipe size and depth of cut.
 - 1) Class B (Type 2) or better bedding shall be used for all PVC sewers.
- b. Comply with ASTM D2321, except as otherwise specified herein.

3. Ductile-iron pipe:

- a. Select proper bedding class from preceding table as determined by pipe size and depth of cut.
 - 1) Class B, Type 2 bedding limited to maximum pipe size of 24", Class 52 at 14' foot depth.
- b. Comply with ANSI/AWWA C600, except as otherwise specified herein.

4. Remove defective pipe and replace with sound pipe, at no cost to the Owner.

3.4 INSTALLATION OF MANHOLES

- A. Set bases level so that walls will be plumb. Install manhole on a minimum of 12" #5 compacted stone.
- B. Clean bells and spigots.
- C. Apply joint sealer, or ring gasket to wall section(s), set firmly in place to assure watertight joints.
- D. Set risers and cones so steps align.
- E. Tightly connect pipe boot to piping with dual stainless steel straps.
- F. Grout lift holes and joints using non-shrink grout.
- G. Install exterior joint collar.
 - 1. Follow manufacturer's recommendations.
 - 2. Clean surface.
 - 3. Remove the protective paper and place the band around the manhole, mastic side to the manhole and spanning the joint.
 - 4. Cover exposed strap with the closing flap.
- H. Where precast inverts are not used, form the invert channels directly in the concrete of the manhole base, with mortar, or by laying full section sewer pipe through the manhole and breaking out the top half after surrounding concrete has hardened. Smooth the floor of the manhole outside the channels, and slope toward the channels at not less than 1" per foot nor more than 2" per foot.
 - 1. Shape the invert channels to be smooth and semi-circular, conforming to the inside of the adjacent sewer section.
 - 2. Make changes in direction of flow with a smooth curve of as large a radius as the size of the manhole will permit.
 - 3. Make changes in size and grade of channels smoothly and evenly.
 - 4. Slope invert uniformly from invert of inlet to invert of outlet.
- I. Install manhole to grade utilizing precast grade rings.

3.5 CONNECTIONS TO EXISTING SYSTEM

- A. Construct new manhole as specified, breaking upper half of existing pipe after base of manhole is completed so as not to obstruct flow of the existing pipe.
- B. At existing manhole tie-ins, temporarily block and/or divert sewage flows, perform other miscellaneous work.

1. Use high-early strength cement for mortar, forming proper channels with minimum interruption to service of the existing sewer.

3.6 SERVICE LINES

- A. Connect to street sewers using sweeping tees as indicated on the plans.
- B. Do not stack service lines vertically over the sewer main.
- C. Provide sufficient fittings to route piping without bending the pipe sections.
- D. Provide couplings where connections are required to existing service lines.
- E. The Contractor is responsible for coordinating with the property owner and the utility owner's representative to determine the depth and location of both the sewer line connection and clean out to best provide a sewer service connection point for the property being served.
- F. The Contractor is responsible for locating service lines to avoid conflicts with existing utilities and exposure of line in ditches.
- G. The Contractor shall install the service lines and cleanouts in accordance with the latest revision of the International Plumbing Code.
- H. The connection to the existing property owner's service line past the point of service (i.e. the cleanout at the edge of the right-of-way) shall be performed by a licensed plumber. The licensed plumber shall obtain a permit from the City of Newberry for every property.
- I. The Contractor (with WL license) may install the service line and clean-out up to the point of service (i.e. the cleanout at the edge of the right-of-way).

3.7 CLEANOUTS

- A. Secure the Owner's approval of location for cleanouts in finished areas prior to installation.

3.8 INSPECTIONS AND TESTING

- A. General:
 1. All sewers will be visually inspected, tested and gauged for infiltration and/or exfiltration.
 2. All visible leaks shall be repaired even if infiltration is within allowable limits.
 3. Broken or cracked pipe, mislaid pipe and other defects shall be corrected.

4. All repairs, relaying of sewers, etc., required to bring the sewers to specified status shall be made at no additional cost to the Owner.
5. Expense of all general testing will be borne by the Contractor.

B. Construction observation:

1. Clean and prepare for observation each block or section of sewer upon completion, or at such other time as the Engineer may direct.
2. Each section between manholes shall show a full circle of light when viewed from either end.

C. Deflection tests:

1. Perform deflection tests on all PVC pipe in the presence of the Engineer.
2. No pipe to exceed a deflection of 5%.
3. Conduct deflection testing after the final backfill, and compaction thereof, has been in place at least thirty (30) days and prior to placing the sewer lines into operation.
4. Conduct the deflection tests using a rigid ball or mandrel having a diameter equal to 95% of the inside diameter of the pipe.
5. Do not use mechanical pulling devices for the deflection tests.

D. Air testing:

1. Where sewers are installed above the groundwater table, conduct air tests complying with ASTM C 828 for ductile iron and concrete pipe and ASTM F 1417 for PVC pipe.

E. Video Inspection:

1. All sewer main lines shall have a post installation video inspection.
2. The Contractor shall video the new sewer main lines and submit the videos of the lines to the Engineer for review.
3. The Owner and Engineer will review the videos to determine if there are any deficiencies in the sewer line installation. The Contractor will be responsible to repair these deficiencies. The Owner's decision will be final.

F. Vacuum Test of Manholes:

1. Vacuum test manholes in accordance with ASTM C-1244.
2. Typical Field Test Procedure.
 - a. The test head gauge shall be placed at the top of the manhole or in accordance with the manufacturer's recommendations.
 - b. A vacuum of 10 in. of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 in. of mercury.

- c. The manhole shall pass if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury meets or exceeds the values indicated in the Table 1 below.
- d. If the manhole fails the initial test, necessary repairs shall be made. The manhole shall then be retested until a satisfactory test is obtained.

3. Minimum test times for various diameter manholes.

TABLE 1 Min. Test Time (sec.) by Manhole Dia.			
Depth of Manhole	4' Dia.	5' Dia.	6' Dia.
0 – 8'	20	26	33
8' – 10'	25	33	41
10' – 12'	30	39	49
12' – 14'	35	46	57
14' – 16'	40	52	67
16' – 18'	45	59	71
18' – 20'	50	65	79
20' – 22'	55	72	87
22' – 24'	59	78	97
24' – 26'	64	85	105
26' – 28'	69	91	113
28' – 30'	74	98	121

END OF SECTION

SECTION 02724

SANITARY SEWER LINE CLEANING

PART 1 -GENERAL

1.1 SCOPE

- A. Work in this section shall consist of furnishing all labor and equipment required to clean existing gravity sanitary sewer mains which are selected for rehabilitation.
- B. Contractor shall be prepared to completely clean and remove roots from all sanitary sewer mains regardless of the quantity of debris or roots. The Contractor shall utilize equipment appropriate for the size and material type of the pipe line.
- C. Related Work
 - 1. Section 02726 - Closed Circuit Television (CCTV) Inspection

1.2 SUBMITTALS

- A. The Contractor shall provide subcontractor and equipment information (line cleaning hydraulics and nozzles, etc.)

PART 2 • PRODUCTS

2.1 WATER

- A. The Contractor shall be responsible for obtaining potable water necessary to support cleaning operations. The Contractor shall coordinate with the local water utility and shall comply with all applicable laws and regulations. The Contractor shall record the quantity (gallons) of daily water used and report such to the Owner and the Engineer on a weekly basis. The Contractor will not be charged for the cost of water if supply is from the Owner's distribution system; all other supply sources will require the Contractor to pay for such at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 PREPARATION

- A. The Contractor shall notify the Engineer and the Owner of all cleaning operations prior to performing the work. The Engineer and/or the Owner may require that a form be completed by the Contractor and submitted to the Engineer.
- B. The Contractor shall either plug or install a flow bypass pumping system to properly clean the pipe lines. Moving material from manhole section to manhole section shall not be allowed. By-

pass pumping systems shall be sized to handle the existing flow rate of the pipe line including peak flows.

**SANITARY SEWER LINE CLEANING
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- C. Precaution shall be taken by the Contractor in the use of cleaning equipment to avoid damage to the existing pipe. Selection of cleaning and root removal equipment shall be based on the conditions of the sewer mains at the time work commences.

3.2 CLEANING

- A. Cleaning operations shall begin at the high end of the sewer system and progress downstream. The Contractor shall remove all internal debris, grease, deposits, and roots from the pipe line. All solids, debris, grease, and roots shall be removed from the downstream manhole and disposed of properly at a SCDHEC approved disposal site.

3.3 QUALITY CONTROL

- A. Closed circuit television inspection shall be utilized to inspect the quality of the Contractor's work. The Contractor shall re-clean and re-inspect sewer line segments that have not been thoroughly cleaned.
- B. The Contractor shall notify the Engineer/Owner immediately of any damage caused by the cleaning equipment. Any repair cost shall be the Contractor's responsibility.
- C. The Contractor shall notify property owners when performing line cleaning within the permanent right of way located on private property. The Contractor shall be responsible for any damage caused to public or private property as a result of line cleaning and preparation operations. The Contractor shall keep the premises free at all times of waste materials and rubbish. Any surface areas damaged or disturbed by the Contractors operations shall be restored to pre-construction conditions or better.

END OF SECTION

SANITARY SEWER LINE CLEANING
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SECTION 02725

BYPASS PUMPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: The Work covered by this Section consists of providing temporary bypass pumping and performing all related operations in connection with routing the flow of wastewater around pipe segment(s) during construction of replacement sewers.
 - 1. Generally, the sequence of Work will be to set up bypass pumping equipment and piping to allow bypassing of wastewater flows around a section or sections of the existing sewer line; construct the new section(s), cleanup, inspect and test the new section(s); begin use of the new sewers; relocate the bypass pumping equipment and repeat the process.
 - 2. The design, installation and operation of the temporary bypass pumping system shall be the Contractor's sole responsibility.
 - 3. The Owner has no method of control of wastewater flows, including infiltration and inflow, in existing sewer lines.
- B. The purpose of bypassing is to prevent wastewater overflows and provide continuous service to all wastewater customers. The Contractor shall maintain wastewater flow in the construction area in order to prevent backup and/or overflow and provide reliable wastewater service to the users of the wastewater system at all times.
- C. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
 - 2. Section 02221 - Trench Excavation, Bedding and Backfill
 - 3. Section 02260 - Erosion and Sediment Control
 - 4. Section 02722 - Gravity Sanitary Sewer Systems

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with requirements of governmental agencies having jurisdiction.
- C. The Contractor shall be responsible for all required pumping, equipment, piping and appurtenances to accomplish the bypass and for any and all damage that results

BYPASS PUMPING

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directly or indirectly from the bypass pumping equipment, piping and/or appurtenances. The Contractor shall also be liable for all of the Owners personnel and equipment costs, penalties and fines resulting from sanitary sewer overflows. It is the intent of these specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow conditions.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit a comprehensive written plan that describes the intended methods, precautions and procedures for bypass pumping and the maintenance of flows during construction.
 - 1. Include sketches or a marked up set of the construction drawings showing the location of bypass pumping equipment for each line segment(s) around which flows are being bypassed.
 - 2. The plan shall include any proposed tanks, pumps, bypass piping, backup plan and equipment. The Plan should address the Contractor's work schedule, monitoring log for bypass pumping, monitoring plan of the bypass pumping operation including nights, weekends and periods when the Contractor is not working (holidays, inclement weather periods, etc.) and maintenance of traffic plan.
 - 3. The plan should address proposed methods of noise control for each pump and/or generator.
- C. The bypass plan shall be approved by the Engineer prior to implementation of the bypass. Should modifications to the bypass pumping plan be required to obtain the Engineer's approval, the Contractor shall revise the plan and implement such at no additional expense.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01640.

1.5 ORDER AND ACCEPTANCE OF WORK

- A. Owner reserves right to begin using any portion of Work whenever it is considered to be in the public interests to do so. However, such use shall not constitute full acceptance of the Work nor beginning of the Contractor's warranty period.

1.6 JOB CONDITIONS

- A. The Contractor should thoroughly familiarize himself with the site, access and security conditions of the project site.

PART 2 • PRODUCTS

2.1 GENERAL

- A. The Contractor shall provide and maintain adequate equipment, piping, tankers and other necessary appurtenances in order to maintain continuous and reliable wastewater service in all wastewater lines as required for construction. The Contractor shall have tankers, backup pump(s), piping and appurtenances ready to deploy immediately.

2.2 BYPASS PIPING

- A. All piping shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi, whichever is greater. During bypassing, no wastewater shall be leaked, dumped, or spilled in or onto, any area outside of the existing wastewater system. When bypass operations are complete, all bypass piping shall be drained into the wastewater system prior to disassembly.

2.3 NOISE CONTROL

- A. Bypass pumps and/or generators shall have a maximum rating of 55 decibels (per bypass set-up) for sound attenuation.

PART 3 • EXECUTION

3.1 GENERAL

- A. The Contractor shall have all materials, equipment and labor necessary to complete the new sewer line installation on the job site prior to isolating the gravity sewer main segment or manhole.
- B. The Contractor shall demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 24 hours prior to beginning the Work.

3.2 PERFORMANCE REQUIREMENTS

- A. It is essential to the operation of the existing system that no interruptions in wastewater flow occur throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as tanks, plugs, pumping equipment (both primary and backup units), conduits, all necessary power, and all other labor and equipment necessary to intercept the incoming flow before it reaches the point where it would interfere with his Work, carry it past the Work area and return it to the existing sewer system downstream of his Work.

3.3 TRAFFIC CONSIDERATIONS

- A. The Contractor shall locate bypass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways and alleys to include the possible temporary trenching of piping at critical intersections. Ingress and egress to adjacent properties shall be maintained at all times. Ramps, steel plates or

others methods shall be deployed by the Contractor to facilitate traffic over surface piping. High traffic and/or commercial properties may require alternate methods.

3.4 INSTALLATION AND REMOVAL

- A. The Contractor shall *remove* manhole sections or make connections to the existing sewer system and construct temporary bypass pumping structures or facilities only at access locations approved by the Engineer as part of the bypass pumping plan.
- B. When plugging or blocking is no longer needed as part of the bypass pumping operation, it is to be removed in a manner that permits blocked wastewater flow to slowly return to normal without surge, to prevent surcharging or causing other disturbances downstream.
- C. When working in manholes, wetwells, tanks or confined spaces potentially containing sewer gases, combustible or oxygen deficient atmospheres, the Contractor shall exercise caution and comply with OSHA requirements.
- D. Bypass pipelines must be located off streets and sidewalks unless expressly approved by the Owner and the appropriate Department of Transportation. Locations on road shoulders shall be as approved by the Owner and the appropriate Department of Transportation. When the bypass pipeline crosses local streets and private driveways, the Contractor must place the bypass pipeline in trenches and *cover* with temporary pavement. Upon completion of the bypass pumping operations, the Contractor shall *remove* all temporary piping, restore all property to pre-construction conditions and restore all pavements. The Contractor is responsible for obtaining any approvals for placement of temporary pipelines or pumping facilities outside of construction easements previously obtained by the Engineer.

3.2 BYPASS OPERATION

- A. The Contractor shall plug off and pump down the sewer manhole or line segment in the immediate Work area and shall maintain the wastewater system so that surcharging does not occur.
- B. Where Work requires the line to be blocked beyond normal working hours and bypass pumping is being utilized, the Contractor shall be responsible for monitoring the bypass operation 24 hours per day, 7 days per week. If accepted in the bypass plan by the Engineer, any electronic monitoring in lieu of onsite monitoring must be detailed in the comprehensive written plan and approved by the Engineer.
- C. The Contractor shall ensure that no damage will be caused to private property as a result of bypass pumping operations. The Contractor shall complete the Work as quickly as possible and satisfactorily pass all tests, inspections and repair all deficiencies prior to discontinuing bypassing operations and returning flow to the sewer manhole or line segment.

- D. The Contractor shall immediately notify the Owner should a sanitary sewer overflow occur and take the necessary action to clean up and disinfect the spillage to the satisfaction of the Owner and/or other governmental agencies. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up and disinfect the spillage to the satisfaction of the Owner and/or other governmental agencies.
- E. When bypassing a pump station, one back-up pump equal to the primary unit shall be required.

END OF SECTION

SECTION 02726

CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION

PART 1 • GENERAL

1.1 SCOPE

- A. Work in this section shall consist of furnishing all labor and equipment required to inspect and document the interior condition of gravity sanitary sewer mains utilizing closed circuit television (CCTV) equipment.
- B. Related Work.
 - 1. Section 02724 - Sewer Line Cleaning

1.2 SUBMITTALS

- A. The Contractor shall provide two sets of the CCTV inspection results to the Engineer/Owner. The inspection results shall be bound in a 3-ring binder and shall include copies of the inspection logs, and video data. The CCTV video files shall be entirely in digital format stored on DVDs in MPEG-4 format. DVDs shall be clearly labeled and cross-referenced with the inspection logs. A PACP database file (PACP export file) of the inspection logs shall also be submitted so that the Owner may import the inspection logs into their Granite XP CCTV software program. Inspection logs shall be in PACP format and identify the following:
 - 1. Surveyor's Name & Certification Number.
 - 2. System Owner.
 - 3. Date of inspection.
 - 4. Time of inspection.
 - 5. Location (Street & City, Town, Etc.).
 - 6. Upstream Manhole number.
 - 7. Downstream Manhole number.
 - 8. Direction of flow.
 - 9. Size of pipe diameter.
 - 10. Shape of pipe.
 - 11. Pipe material (PVC, VCP, DIP, etc.).
 - 12. Length of segment.
 - 13. Tape/Media No.
 - 14. Pre-clean.
 - 15. All structural defects.
 - 16. All operational and maintenance defects.
 - 17. All construction features.
 - 18. All pipe material changes.
 - 19. PACP Condition Grading Report for each line segment.

. PART 2 • PRODUCTS

2.1 EQUIPMENT

- A. The camera equipment used for the CCTV inspections shall be specifically designed and constructed for sanitary sewer inspection. All inspections shall be in PACP format. The database shall be an unmodified NASSCO-PACP Certified Access Database. CCTV Software shall be NASSCO-PACP certified. All CCTV inspection shall be within 3 feet of the actual sewer length as measured above ground from center of manhole to center of manhole.
- B. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. The camera shall be a color, pan-and-tilt, radial viewing, pipe inspection camera that pans ± 275 degrees and rotates 360 degrees. The camera lens height shall be centered at one-half the inside diameter in the pipe being televised. The picture quality and definition shall be of a high quality and approved by the Engineer providing review.
- C. The video camera shall be required to show the following information on the Header Screen at the start of the inspection:
 - 1. Owner's name
 - 2. Project name
 - 3. Contractor name
 - 4. Date
 - 5. Line size and material
 - 6. Line identification (Owner's manhole numbers at both ends)
- D. The video camera shall be required to show the following information continuously on the digital inspection:
 - 1. Start and End Manholes
 - 2. Footage Counter
- E. CCTV shall proceed from upstream to downstream unless otherwise approved by the Engineer.
- F. The CCTV inspections shall start at the center of the start manhole and end at the center of the end manhole. The camera shall be panned and tilted inside each manhole to show a view of the manhole.
- G. If a blockage cannot be removed and hampers the video taping of the sewer in one direction, then the Contractor shall attempt to complete the section by televising from the downstream manhole to complete the section. This reversal must be performed immediately after the initial inspection, meaning the inspection log and video shall immediately follow the initial inspection log and video. The Contractor must immediately report any obstruction to the Engineer. The Contractor must also consider weather conditions and delay video work if the flow of the system is impacted by major rain events.

- H. The speed of travel shall be slow enough to inspect the entire circumference (360 degrees) of the pipe, each pipe joint, tee connection, structural deterioration, infiltration and inflow sources, and deposits, but should not, at any time, be faster than 30 feet per minute. The camera must be centered in the pipe to provide accurate distance measurements to exact locations of features in the sewer and these footage measurements shall be displayed and documented on the video.
- I. The camera shall move through the sewers via self-powered tractor assemblies. Skid assemblies shall not be permitted. The tractor assemblies used for the inspection shall be appropriately sized for the pipe being televised in accordance to the manufacturer of the television equipment.

PART 3 • EXECUTION

3.1 PREPARATION

- A. The Contractor shall clean the lines prior to inspection. By-pass pumping, in accordance with Section 02725 of these specifications, shall be used when it is necessary to inspect the entire circumference of the pipe (post HOPE Pipe Bursting installation, etc.). The pump and bypass lines shall be of adequate capacity and size to handle peak flows.
- B. The Contractor shall notify property owners when performing inspection within permanent right-of-way located on private property. The Contractor shall be responsible for any damage occurring from equipment on private property (driveways, grassed areas, etc.). The Contractor shall keep the premises free at all times of waste materials and rubbish. Any surface areas damaged or disturbed by the Contractor's operations shall be restored to original conditions or better.

END OF SECTION

SECTION 02728

PIPE BURSTING

PART 1 - GENERAL 1.1

DESCRIPTION

A. Work included: Provide labor, equipment, materials, tools, etc., necessary to pipe burst and upgrade the existing sanitary sewer lines as indicated and specified.

1. Work to perform on existing lines as indicated on the contract drawings.

2. All pertinent information, such as location, size and length, are indicated on the contract drawings. B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 02221 - Trenching, Backfilling for Utilities.
3. Section 02722 - Sewers: Sanitary, Gravity. 4. Section 02722 - Sewers: Sanitary, Gravity.
5. Section 02724 - Sanitary Sewer Line Cleaning 6. Section 02722 - Sewers: Sanitary, Gravity.

C. This section specifies the system, method, or process to include all labor materials, tools, equipment and incidentals necessary to provide for the complete rehabilitation/replacement of deteriorated pipe by the Pipe Bursting System. Pipe bursting is the construction technique of replacing an existing, underground pipe system in situ by simultaneously "bursting" the existing pipe and installing a new pipe in its place. Essentially, the process involves the use of a static "moling" device, suitably sized to break out the old pipe with flared plug that bursts the existing pipe. Forward progress of the "mole" shall be aided by the use of hydraulic static pull method. The replacement pipe is either pulled or pushed into the bore.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Reference standards: Comply with the following codes, specifications and standards, except as otherwise shown or specified:

1. American Society for Testing and Materials (ASTM) Publications:

D 2321 Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe

D 2657 Practice for Heat-Joining Polyolefin Pipe and Fittings

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- D 3035 Specification for Polyethylene (PE) Plastic Pipe Based on Controlled Outside Diameter (up to 6-inch IPS)
- D 3350 Specification for Polyethylene (PE) Plastic Pipe and Fittings Materials
- F 585 Practice for Insertion of Flexible Polyethylene (PE) Pipe into Existing Sewers
- F 714 Specification for Polyethylene (PE) Plastic Pipe Based on Outside Diameter (3-inch IPS and larger)
- F 477 Specification for Elastomeric Seals (Gaskets) for Joint Plastic Pipe
- F 894 Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

- C. Certification: The Contractor shall provide qualifications to the representative upon request, evidence of competency, and authority to perform pipe bursting. The qualifications shall at a minimum include the following:
- D. Pipe Bursting Experience: The Contractor shall have a minimum of two (2) years of experience in the pipe bursting business and a record of at least four (4) mile of pipe bursting using the hydraulic static pull method and pre-chlorination. The contractor has to be certified by the AWWA in pre-chlorination.
- E. Pipe Bursting Certification: The Contractor shall be trained by the pipe bursting equipment manufacturer in the use of the equipment for pipe bursting.
- F. Pipe Bursting Patent: The Contractor shall be licensed for the use of the pipe bursting technology patent.
- G. Thermal Fusion Training: The Contractor shall be trained by the thermal fusion equipment manufacturer in the use of the equipment for thermal butt-fusion of high-density polyethylene (HDPE) pipe.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 01340.
- B. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 - 3. Material Safety Data sheet (Form OSHA-20 or equivalent) for each material to be used, outlining proper fire and explosion data, health hazard data, spill and leak procedures and protection equipment information.

C. Construction schedules: Submit construction and bypassing schedules for approval by the Engineer.

1.4 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01640.

PART 2 - PRODUCTS

2.1 CLEANING EQUIPMENT

A. Provide equipment specifically designed for the purpose intended.

B. All equipment shall be approved by the Engineer prior to use.

2.2 TELEVISION SYSTEM

A. Provide equipment with high performance capabilities, produced by a manufacturer engaged in the research, development and manufacturing of said equipment.

B. Provide a self-contained system complete with:

1. Closed circuit television camera.
2. Monitor.
3. Video recorder.
4. Measuring device to accurately determine the position of the camera in the line being televised.
5. Accessory' equipment as necessary for the successful completion of television inspection.

3.1 MATERIAL SPECIFICATIONS

3.2 Pipe

Pipe shall be high-density polyethylene (HOPE) with a **SDR 17** rating. The pipe size shall be based on the **JPS** outside diameter. HOPE resin shall be **PE3408/PE4710** resin characterized by ASTM 03350. The HOPE pipe shall be easily identifiable with a minimum of one stripe integrally extruded longitudinally in the exterior of the pipe wall or be of a solid color according to the County color applicable to the service. Mains for gravity sewer applications shall be **BLACK** color for ease of viewing when televising.

4.1 EXECUTION

4.2 Materials Handling

No materials shall be dumped, dropped, pushed or rolled into a trench. Pipe may be pulled longitudinally into the trench after fusion of the pipeline. Pulling of the main shall be accomplished by mechanical action during pipe bursting operations.

PIPE BURSTING

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4.3 Pipe Bursting

Prior to commencement of the construction, the Contractor shall submit to the Owner a pipe bursting plan which shall minimally include pit locations and schedule, service line replacement, bursting distances and directions, and service outage and reinstatement schedule.

Pipe bursting shall be accomplished using the hydraulic method. In general, the bursting operation shall be as follows:

- Post notices of service interruption and outages as indicated in the pipe-bursting plan.
- Isolate the existing system and excavate launch, bursting, and service pipes as indicated in the pipe-bursting plan.
- Construct placement service lines.
- Set up the bursting equipment in the bursting pit and insert the bursting rods or cable through the host pipe.
- Connect the bursting head to the main and the bursting rods or cable in the launch pit.
- Burst the existing main.
- Install new service connection fittings and connect new service lines.
- Flush the new main then connect the new main to the existing system; and
- Continue this series of operation to complete the full scope of burstings.

4.4 Launching and Bursting Pit

Pits shall be strategically located along the alignment of the pipe to be burst to minimize the quantity of pits. The Contractor shall prepare a pit location schematic illustrating the planned pit locations and schedule for pit excavation, backfilling and restoration.

The duration that pits are open shall be kept to a minimum. Pit locations shall consider locations of existing and proposed valves, hydrants, fittings, services, and isolating sections of the existing system to minimize service interruption to customers.

4.5 Service Pits

Pits shall be required to install service connection fittings and reconnect services to the newly installed pipe.

4.6 Service Line Replacement

The pipe-bursting plan shall include the schedule for replacing service lines and method for replacing lines {bursting existing service lines and /or moling new service lines}.

4.7 Bursting Distance and Directions

The Contractor shall include in the pipe bursting plan distances and directions of the bursts to be performed.

4.8 Service Outage and Reinstatement

The contractor shall minimize service interruption to customer. Service outage shall be strictly limited to the hours of 8:00 AM to 5:00 PM, Monday through Friday. No service interruption

shall be allowed from 5:00 PM to 8:00 AM, Monday through Friday or at all on Saturdays, Sundays, or legal holidays. The pipe-bursting plan shall include the days and hours planned for service outage and reinstatement to each customer.

NOTE: If off hours bursting is anticipated, special permission must be obtained. The Contractor shall coordinate with the Owner and post notices to the customers a minimum of 48 hours prior to service interruption.

4.9 Pipe Jointing

Sections of polyethylene replacement pipe shall be assembled and joined on the job site *above* the ground. Jointing shall be accomplished by the heating and butt-fusion method in strict conformance with the manufacturer's printed instructions. The buttfusion method for pipe jointing shall be carried out in the field by certified operators with prior experience in fusing polyethylene pipe with similar equipment using proper jigs and tools per standard procedures outlined by the pipe manufacturer. These joints shall have a smooth, uniform; double rolled back bead made while applying the proper melt, pressure, and alignment. It shall be the sole responsibility of the Contractor to provide an acceptable butt-fusion joint. WHO shall make all joints available for inspection before the insertion. The replacement pipe shall be joined on the site in appropriate working lengths near the insertion pit.

4.10 Joining and Connections

Before joining and before any special surface preparation, surfaces must be clean and dry. General dust and light soil may be removed by wiping the surfaces with clean, dry, lint-free cloths. Heavier soil may be washed or scrubbed off with soap and water solutions, followed by thorough rinsing with clean water, and drying with dry, clean, lint-free cloths.

4.10 Cutting Pipe

Joining methods for plain end pipe require square-cut ends. Pipe cutting is accomplished with guillotine shears, run around cutters, and saws.

4.11 Cutting Branch Outlet Holes

Except for self-tapping saddle tees, hole cutting is required for field installed side outlet fittings. Polyethylene pipe hole saws shall be used.

4.12 Heat Fusion Joining

Heat fusion joining is the process where mating surfaces are prepared for joining, heated until molten, joined together, and cooled under pressure. All fusion procedures require appropriate surface preparation tools, alignment tools, and temperature controlled heating irons with properly shaped, non-stick heater faces. An open flame cannot be used for heating because it oxidizes the surface and prevents bonding. During joining, all heat fusion procedures require the mating components to be moved several inches apart to accommodate surface

preparation and surface heating tools. All fusions shall be constructed in strict accordance with pipe and fitting manufacturers' recommendations.

4.13 Socket Fusion

Socket fusion shall be used with $\frac{1}{2}$ inch through four-inch pipe and fittings.

4.14 Saddle Fusion

Saddle fusion outlets may be used for eight-inch and smaller outlets applied to twelve inch and larger mains. Larger outlets for larger main sizes shall be factory fabricated.

4.56 Butt Fusion

Butt fusion joints shall be field constructed between pipe and fittings. Fusion may occur in the trench.

4.17 Electrofusion

Electrofusion is a heat fusion process where a coupling or saddle fitting contains an integral heating source. After surface preparations, the fitting is installed on the pipe, and the heating source is energized. During heating, the fitting and pipe materials melt, expand, and fuse together. Heating and cooling cycles are automatically controlled.

5.0 RECORD DRAWINGS

Services, fittings, and all other reconnections to the replaced pipes shall be identified and marked in the construction drawings by the Contractor. The Contractor shall be responsible for marking the construction drawings in reference to at least two fixed and easily found points. The Contractor shall submit to the Owner record drawings within 15 calendar days from the date of completion of the job.

6.1 GRAVITY LINES PIPE BURSTING

6.2 Pre-Installation Video Inspection

It shall be the responsibility of the Contractor to video inspect the main prior to pipe bursting to assure that existing pipe conditions are acceptable for pipe bursting, and to locate all active service line connections. This inspection as well as the video inspection after the installation shall be paid for per the unit price per linear foot of pipe bursting as stated in the Measurement and Payment Section of the Contract Documents. Contractor shall provide one copy of each video inspection to the Owner.

6.3 Post-Installation Video of Completed Sections

The Contractor shall provide the Owner a color video recording (digital) taken by a pan and tilt camera that pans 275 degrees and rotates 360 degrees for close up view showing the completed work, including the condition of the restored service connections.

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6.4 Bypassing Sewage

In wastewater applications, when required for acceptable completion of the pipe bursting, the Contractor shall provide for continuous sewage flow around the section(s) of pipe designated for pipe replacement. The pump bypass discharge lines shall be rigid of adequate capacity and size to handle flow, solid PVC with socket welds or HOPE butt-fused. Lay flat piping may be used when permitted by the Owner. Prior to disassembling the discharge piping, the piping shall be flushed with clean water in its entirety. The cost for flushing operations and water shall be incidental to the bypass piping.

When bypassing conditions require overnight or non-working days operation, a standby bypass pump of the same size as the primary pump shall be on-site ready for emergency use in the event that the primary pump fails. Payment for the standby pumping shall be paid for per the unit price per linear foot of pipe bursting as stated in the Measurement and Payment Section of the Contract Documents.

6.5 Sags in Line

If pre-installation video inspection reveals a sag in the existing sewer that is greater than one-half the diameter of the existing pipe, it shall be the Contractor's responsibility to install the replacement pipe to the result in an acceptable grade without the sag. The Contractor shall take in necessary measures to eliminate these sags, as directed by the Owner. Pipe replacement, digging a sag elimination pit, and bringing the bottom of the pipe trench to a uniform grade in line with existing pipe invert or by other measures that shall be acceptable to the Owner. Payment shall be as per bid item for open cut sewer line installations.

6.6 Sealing and Benches in Manhole

The replacement pipe shall be installed with a tight fitting seal with the existing or new manhole. A Fernco CMA Water Stop Gasket or approved equal shall be placed circumferentially on the replacement pipe and encased with cementitious non-shrink grout to prevent inflow at the manhole. The top half of the pipe within the manhole shall be neatly cutoff and not broken or sheared off, at least four inches away from the manhole walls. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines or channels, if any. Channel cross-section shall be U-shaped with a minimum height of half pipe diameter to three-fourths of the pipe diameter for fifteen inches and larger. The side of the channels shall be built up with mortar/concrete, as specified, to provide benches at a maximum of one in 12 pitch towards the channel.

The replacement pipe in the manhole shall be sealed as specified above before proceeding on to the next manhole section and all manholes shall be individually inspected for replacement pipe outfalls, benches and sealing. Where excavations for the insertion of the replacement pipe are made between two manholes, the ends of the pipe will be cut smooth and square to the axis so that it can be joined in a workman like manner such that both ends meet and touch uniformly and continuously. A full circle repair clamp (Mission ARC Coupling or approved equal) shall be used.

6.7 Sewer Service Laterals and Connections

Existing service connections shall be located before initiating sewer main replacement operations. Service laterals shall be reconnected to the new sewer line after replacement and before video inspection is completed. Any services remaining off line for an extended period of time, or any connections as deemed necessary by the Owner to protect the customer, shall be bypass pumped until such time that they can be reconnected.

Connection of the new service lateral, green color (ASTM D-3034 SOR 35 PVC Pipe) to the new sewer main shall be accomplished by use of the watertight service connection. The service connection shall be specifically designed for connection to the HOPE sewer main being installed, and shall be ROMAG Style "CB" Sewer Saddle, as manufactured by Romac Industries, Inc., or an approved equal. Surface materials to be removed for excavation purposes shall be replaced to the condition they were prior to excavation.

7.1 CLEAN-UP OPERATIONS

- A. Use proper procedures for waste disposal of all residues, adhering to manufacturer's recommendations.
- B. Disposal to be at a sanitary landfill site or other applicable disposal site.
- C. All equipment and work areas to be cleaned properly and completely.
- D. Failure to maintain work sites properly cleaned up will be sufficient cause for withholding of monthly payments to the Contractor.

8.1 TRAFFIC CONTROL

- A. Perform all traffic control in strict accordance with the requirements of the South Carolina Department of Transportation.

END OF SECTION